

JULY 1980 \$1.25

Popular Mechanics

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home computer
add-ons

Make a basement
water alarm

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TR8 • Rover 3500 • Peugeot 505**

**After 1½ million miles:
Owners cheer Chevy
Caprice mileage and
Ford T-Bird
styling**



**PM GUIDE
BUILD THESE NEW
ULTRALIGHT PLANES**

**Plans
Inside**



11 COMPLETE PLANS

- Build our bike-wheel garden cart
- 5 handy shop aids to make
- Create 3' 'stained glass' hangings
- Build this bike stand in a jiffy
- Make steel barbecue skewers



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EPA EST. MPG

EST. HWY.

DATSUN EPA EST. MPG **24** EST. HWY. **31**
TOYOTA EPA EST. MPG **21** EST. HWY. **28**

Remember: Compare the "estimated MPG" to that of other vehicles. You may get different mileage, depending on how fast you drive, weather conditions and trip length. Actual highway mileage will probably be less than the highway estimate. Lower in California.



**BEST MILEAGE OF
ANY 4-WHEEL-DRIVE TRUCK.**

(WITH STANDARD ENGINE AND TRANSMISSION)

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22

EPA EST. MPG

30

EST. HWY.

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Craftsman 10-inch radial saw.

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you owe it to yourself to try a set of Radial-Matics on your car. When you do, we're confident Monroe will have won your allegiance forever.

**AMERICA
RIDES
MONROE**

Monroe Auto Equipment
Division of Tenneco Automotive





On the cover

Whether homebuilt or merely home-assembled, ultralight aircraft like this Mitchell Wing are looking more and more like real airplanes. PM's story on page 80 tells you all about the revolution in designs, materials and powerplants.
—PM painting by Ed Valigursky

Popular Mechanics®

JULY 1980

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AS A SERVICE TO READERS, Popular Mechanics publishes newsworthy products, techniques and scientific and technological developments. Due to possible variance in the quality and condition of materials and workmanship, Popular Mechanics cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects resulting from plans published in this magazine.

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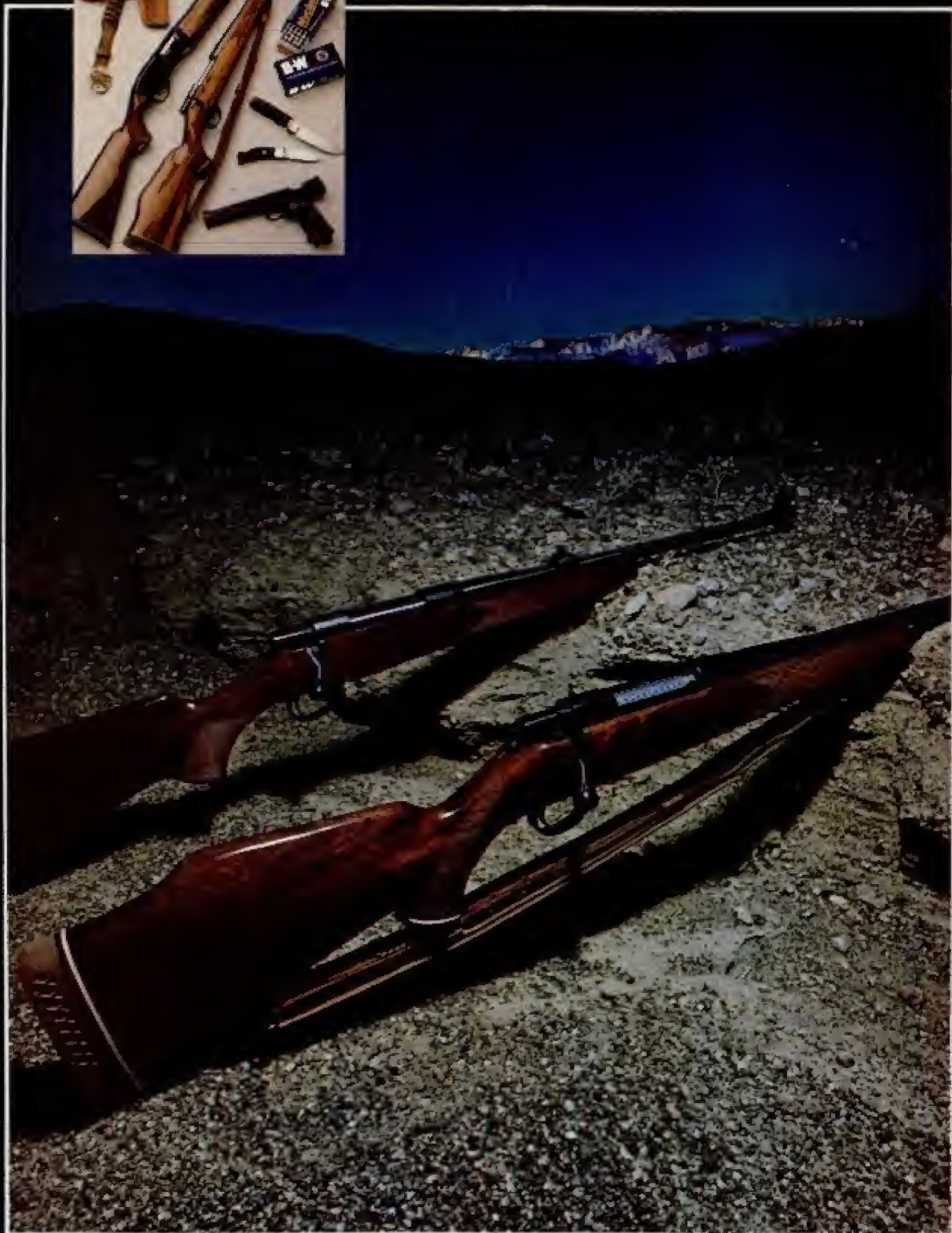
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The rugged beauty of the American west is a natural setting for these new Smith & Wesson Model 1500 centerfire rifles. Their smooth, flowing lines bring a new dimension to bolt action design. The natural warmth of hand-rubbed American walnut flows smoothly into the lustrous blue and sparkling chrome of metal. You can see the beauty and quality of these new rifles. But you'll have to visit your dealer to feel their near perfect balance. And shoot them to experience Smith & Wesson accuracy. In popular calibers. Deluxe (Magnum, foreground) and standard versions. Smith & Wesson, 2100 Roosevelt Avenue, Springfield, Massachusetts, 01101.



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LETTERS TO THE EDITOR

Pro propane

Thank you for your article on propane carburetion in the April '80 issue (*My 30,000 Miles on Propane*, page 108). I am a manufacturer of propane cookers and torches and have converted and operated several dual-fuel units. Currently our stock includes a '62 GMC pickup with 450,322 miles on it. It has never had engine work more major than a tune-up. We replace plugs, oil and filter every year. We also have a '76 Dodge D100 pickup with 101,563 miles and no problems.

The article mentions having trouble switching from one fuel to another. At speeds above 40 mph, I can switch immediately with no difficulty. It is a problem, however, when I have to switch in traffic.

BENNY GAY
DONALSONVILLE, GA.

No amateur he

I have enjoyed your magazine very much since I first subscribed three

years ago. One of the features I have really appreciated is Shop and Crafts. Enclosed is a picture of items I made from your plans. Mary Lincoln's vanity mirror was in the Feb. '78 issue (*Two Authentic Lincoln Reproductions*, page 102), and the colonial spice box was in the Nov. '79 is-



Lincoln reproductions of Robert Clarke.

sue (*Twelve Gifts You Can Make and Give*, page 122).

The small box with a single drawer is a recipe file of my own design. Your plans, materials lists and exploded views make it possible for

even an amateur woodworker like me to do a nice job.

ROBERT CLARKE
SILVIS, ILL.

Greased lightning

Beyond the Bullet: Japan's New Train Shoots For More Speed (page 95, Apr. '80) was most interesting. The principle of magnetically propelled trains goes as far back as 1907 at least, as the autobiography of Tom Johnson describes: "A structure was built across the top of the cellar and consisted of a series of magnets that were energized at the proper time to lift the car and carry it forward . . . 'Greased Lightning' actually moved. The car was propelled forward and backward as rapidly as it was safe to permit in the short 90 feet of track in the cellar. . . . It was practically agreed that General Electric was to furnish the money for an experiment on a large scale; a two-mile track was to be built at Schenectady . . . It was found

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that the proposed experiment would cost at least half a million dollars. The company decided that it would not be justified in expending so large an amount on an experiment ..."

Johnson, a former mayor of Cleveland, was a millionaire and at one time owned street railroads in Louisville, Indianapolis, Detroit, Brooklyn and Cleveland. I wonder if GE would risk a half million now on the experiment Mayor Johnson tried to promote?

BOB LEE MOWERY
DIRECTOR OF UNIVERSITY LIBRARIES
WITTENBERG UNIVERSITY
SPRINGFIELD, OHIO

I'd like to remark about the article on "maglev" trains. First, the aerodynamic flaws in the cover picture: A) the rooftop air intake is poorly designed; B) the central spine is an impediment to both airflow and vision; C) the transition from frontal slope to roof line is too abrupt; D) the rectangular red lights will cause trapped air pockets and disturbing airflow (red lights in front on a rail car?); E) the tunnel for tracking rail has sharp edges at entry which will "scream" at speed.

Second: Over 100 mph, wind noises would be very annoying inside and especially outside. At 300 mph, vibration would be a problem, and some protrusions might be damaged.

My remarks are to register my dislike of the promise held out to the layman of fast, quiet and economical transportation. The SST is quiet for the passengers, at a price, but is an intolerable nuisance for those on the ground. I am afraid the train pictured and described fits the same pattern.

DONALD G. CLARKE
LOS ANGELES

Hoodwinked?

As a police officer, I was appalled to see "Sweet Hitchhiker" (*It's New Now*, page 51, July '79). I am also concerned that the Federal government granted Commuter Connection \$70,000 of our tax money to energize criminal activity by suggesting people hitchhike to reduce fuel consumption.

I am concerned about fuel conservation, but to encourage hitching instead of car pooling is to encourage criminals to ply their trade in assault, rape, armed robbery, kidnap-

ping, etc. Almost all law-enforcement agencies discourage hitchhiking and in some states it is illegal. I believe Commuter Connection hoodwinked the government by obtaining the \$70,000.

LT. HARRY A. COOK
HAMPTON POLICE DIV.
HAMPTON, VA.

It's a clean machine

I read "Life Begins at 20" (*Appliance Clinic*, page 71, Feb. '80) with interest. I have a top-loading GE dishwasher—serial number 47-335-264—that has been in use since 1947. It is still going strong, and has the original parts, except for an impeller that tangled with a fork about 15 years ago. For my dishwasher, life begins at 33. Can anyone top this?

ANTHONY VIOLI
STEUBENVILLE, OHIO

Acknowledgement

In *How You Can Haul a Big Harvest From a Small Plot* (page 157, Mar. '80), we neglected to mention that the drawings used in the story were rendered from photos and artwork in *Ortho Books' Wood Projects for the Garden*, copyright © 1976, Chevron Chemical Co.

MOTORCRAFT

Motorcraft Super Premium 10W-40 Motor Oil

YEAH, AND WE'LL BE IN RETAIL OUTLETS SOON. WATCH FOR US!

Motorcraft

...FOR SURE

PM ELECTRONICS MONITOR

AM stereo—at last!

After years of tests, petitions, and confusion, the Federal Communications Commission has announced that AM stereo should be a reality by year's end. If everything proceeds smoothly, August should see the final legalization. If the FCC receives "petitions of reconsideration," it might delay things until Christmas.

But you can bet the first AM-stereo broadcasters will show up on the dial as soon as they can. We predict at least one clear-channel station of 50,000 watts broadcasting the first AM stereocasts on the very day the law takes effect.

The Magnavox system won out over four other noncompatible systems. According to an FCC official we spoke with, the Magnavox system offers great fidelity and reliability. He said the decisive factor was not that the others were poor, but the Magnavox system seems to have everything in one package.

This does not obsolesce your present AM receiver. Though AM stereo will require a slightly wider bandwidth, present tuners will be able to receive it—but in monophonic (nonstereo) sound. So, even if sooner or later all stations go stereo, your present tuner may live to be a useful antique.

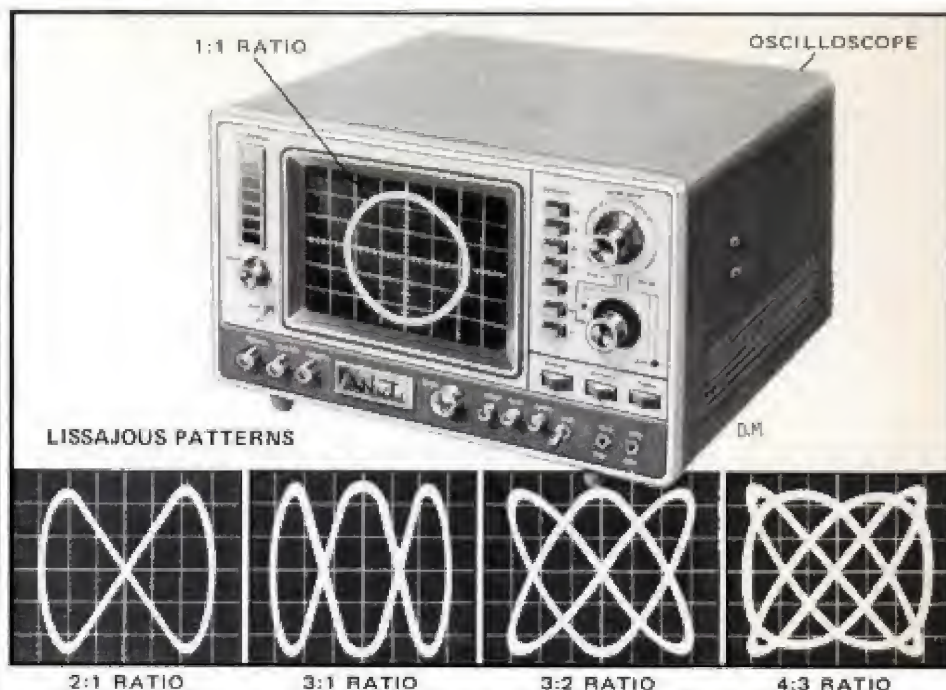
The FCC official mentioned an interesting point: The Magnavox system requires no complex circuitry. He expected to see a number of kits on the market to convert AM receivers to stereo. We'll look into this and, with any luck, you can expect to see a do-it-yourself AM stereo converter featured in our pages soon.

If stereo does for AM what it did for FM, then AM radio will be one big, revitalized marketplace.

Those great shows of yesteryear

Only one thing was more beautiful, detailed and polished than an old-time radio's cabinetry—and that's the shows it received. Breathe a sigh of electronic nostalgia for the likes of *The Green Hornet*, *Lum and Abner*, *Jack Benny Hour*, *The Lone Ranger* and other oldies.

Such past, but never-forgotten, delights can be yours again (or for the first time if you're a youngster) if you'd care to join other radio buffs in the Indiana Recording Club. The club maintains a big lending library of cassette tapes. Dues are \$10 the first year, \$7/year thereafter and the cassettes are loaned for a dollar



How to Interpret Lissajous figures

An oscilloscope is a very handy test device to have on your electronic workbench. But many people are scared off from purchasing one on the theory that it is just too complex to use except for a professional. This is simply untrue.

To illustrate, we show one of the uses of an oscilloscope: finding the frequency of one voltage by comparing it to the known frequency of another.

One voltage is applied to the horizontal plate input of the scope, the other to the vertical input. If the ratio between the two frequencies can be expressed in integers, a stationary pattern will be produced.

This pattern is called a *Lissajous figure*.

apiece for an old show, half a buck for a song.

Write for more information (send return postage) to: Indiana Recording Club, Bill Davies, 1729 East 77th St., Indianapolis, Ind. 46240.

Red means cats and dogs

Pilots will soon be taking advantage of RCA's new Rain Echo Attenuation Compensation Technique (or R.E.A.C.T.) which offers radar-generated storm warnings. The colored radar display indicates position and intensity of storms; colors vary from yellow for weak to red for stormy.

As rain attenuates radar (shields against), past systems have been blind to many storm conditions.

Try, try again

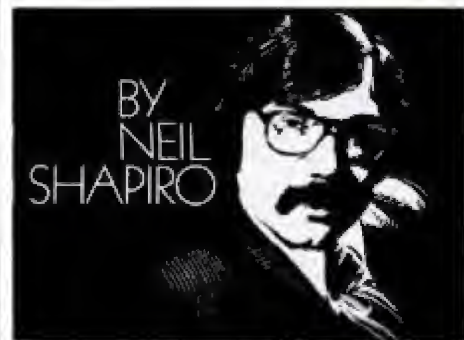
Home computers have spawned a few thousand games and a few billion arguments that all begin "Well, I would have won if only I had..." Now, one company will let you prove it.

Once you have the Lissajous figure on your scope it is a simple matter to calculate the unknown frequency.

Lissajous figures graphically show the ratio between the known and unknown frequency. All you have to do is count the loops along two adjacent edges.

Look at the figure labeled 3:1 ratio. There are three loops along the horizontal edge and one along the vertical. The other ratios are calculated the same way. For instance, the 3:2 Lissajous figure has three loops along the horizontal and two along the vertical. No matter what scope you use, Lissajous figures always look the same.

Powersoft's latest releases for the Apple II, *Dynamaze* and *Ultra Blockade*, can be played against an Apple II solo or with another human opponent. But the action can be stopped at any time. Then the game can be *reversed*. At the critical play the computer will allow you to start over and prove it was just a momentary lapse that lost you the game. The two games are in Powersoft's new line. Its address is Powersoft, Box 157, Pitman, N.J. 08071. **PM**





Right to the finish, its Canadian spirit stands out from the ordinary. What keeps the flavor coming? Super lightness. Superb taste. If that's where you'd like to head, set your course for Lord Calvert Canadian.

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Clear, rippling waters. And
country fresh Salem menthol.
That's satisfaction.

THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

Beeping for mileage

Since the response to our article on vacuum gauges was overwhelming (*Driving For Economy*, page 109, Mar. '80), we thought you might be interested in another gauge that has been introduced recently. It's



Vacuum gauge beeps when you waste gas.

called Easy-Test Audible Vacuum Gauge, and, as the name implies, warns you with a little beep when you're driving inefficiently.

An automatic override feature deactivates the beep when you accelerate hard. It retails for \$14.95, is also available by mail. Contact Harvey-Westbury Corp., 81 Urban Ave., Westbury, N.Y. 11590.—T.A.

Pocket-sized pumps

Here's some good news for motorcyclists who don't want to get caught with a flat tire in the middle of nowhere. Three pumps—appropriate-



Portable motorcycle pumps travel easily.

ly named Mini-, Midi- and Maxi-Pump—are designed to fit in your toolkit or tank bag, and can fill a flat in a few minutes.

The biggest pump is the Maxi, the one I carry, which is 6 inches long and weighs a mere 2.14 ounces. It pumps out 4.05 cu. in. of air per stroke and can inflate a tire up to 75

pounds per square inch (p.s.i.). The Mini and Midi deliver 1.38 and 2.16 cu. in. of air per stroke, respectively. Prices start at \$6.95; the pumps are available from S&W Products, 2617 West Woodland Drive, Anaheim, Calif. 92801.—T.A.

Mini-dumpster

If you've ever wished that you could tilt up the bed of your mini pickup to unload a cargo of sand, gravel or even leaves, here's something that could make life easier. The Model 38 JiffyDump uses a heavy-duty Arlyn plastic mat and turning bar. Stretch



Dumpster will unload up to a half ton.

the mat and load up. To unload, reel in the mat. It can handle a half ton load and sells for \$299.95. The mini-dumpster is available from Jiffy-Dump Inc., 343 East Lexington Ave., El Cajon, Calif. 92020.—G.W.

The best defense

Whether you have a brand-new car or a worn out buggy, there's a thief who'd like to get his hands on it. The high cost of replacement parts today makes even an old clunker a



Low-cost alarm provides vehicle security.

very appealing target for stripping.

A reasonably priced theft deterrent is Pittway's Vehicle Security System. It features a powerful 105-decibel siren, one of the loudest we've heard, and an exit-delay func-

tion. You can purchase the alarm for \$69.95 from the Pittway Corp., 780 McClure Ave., Aurora, Ill. 60507.—T.A.

More on Whitney

In the April issue of PM we ran an item on J.C. Whitney, stating that the firm was back in business after clearing up some financial difficulty with its printer. At the time, we were led to believe that the problem did not involve Whitney customers. Well, the blizzard of letters from our readers soon dispelled that notion.

All the letters we received said basically the same thing: I sent my order and got neither merchandise nor my money back. The feelings expressed in the letters were that Whitney had conned its customers, and that PM was adding insult to injury. Obviously, an explanation is in order and here it is.

According to a spokesman for Whitney, the company filed for financial restructuring and was doing business under a Chapter XI proceeding. What this means is that the court freezes debts and gives the firm a chance to reorganize without closing its doors. In Whitney's case, any orders received prior to June 25, 1979, could not be filled by mandate of the court. Orders received after June 25, 1979, were filed and have continued to be at the rate of 30,000 per week.

If you happened to be one of the unlucky customers, all is not lost. You still have legal recourse and here's what you should do. Write to: Clerk, United States District Court, 219 South Dearborn St., Chicago, Ill. 60604. Request a proof-of-claim form and be sure to include the claim number: 79 B-5784.

Once you've filled out the form and mailed it back to the court, you will become a Creditor of Record. That means you'll be guaranteed a place in line when the court orders Whitney to pay off its creditors. At this time, nobody knows how much money the creditors will collect, or when. As soon as the court decides, all creditors will be notified about the payment schedule.

A lot of our readers were burned and I'm sure they're still steaming. And rightly so. But at the time we ran the mention, Whitney was filling orders. We just want to tell those readers we weren't giving them a bum steer and never would.—T.A.

STEREO BREAKTHROUGH

Bone FoneTM

*A new concept in sound technology
may revolutionize the way we
listen to stereo music.*

*The Bone Fone surrounds your entire body
with a sound almost impossible to imagine.*

You're standing in an open field. Suddenly there's music from all directions. Your bones resonate as if you're listening to beautiful stereo music in front of a powerful home stereo system.

But there's no radio in sight and nobody else hears what you do. It's an unbelievable experience that will send chills through your body when you first hear it.

AROUND YOU

And nobody will know you're listening to a stereo. The entire sound system is actually draped around you like a scarf and can be hidden under a jacket or worn over clothes.

The Bone Fone is actually an AM/FM stereo multiplex radio with its speakers located near your ears. When you tune in a stereo station, you get the same stereo separation you'd expect from earphones but without the bulk and inconvenience. And you also get something you won't expect.

INNER EAR BONES

The sound will also resonate through your bones—all the way to the sensitive bones of your inner ear. It's like feeling the vibrations of a powerful stereo system or sitting in the first row listening to a symphony orchestra—it's breathtaking.

Now you can listen to beautiful stereo music everywhere—not just in your living room. Imagine walking your dog to beautiful stereo music or roller skating to a strong disco beat.

You can ride a bicycle or motorcycle, jog and even do headstands—the Bone Fone stays on no matter what the activity. The Bone Fone stereo brings beautiful music and convenience to every indoor and outdoor activity without disturbing those around you and without anything covering your ear.

SKI INVENTION

The Bone Fone was invented by an engineer who liked to ski. Every time he took a long lift ride, he noticed other skiers carrying transistor radios and cassette players and wondered if there was a better way to keep your hands free and listen to stereo music.

So he invented the Bone Fone stereo. When he put it around his neck, he couldn't believe his ears. He was not only hearing the music

and stereo separation, but the sound was resonating through his bones giving him the sensation of standing in front of a powerful stereo system.

AWARDED PATENT

The inventor took his invention to a friend who also tried it on. His friend couldn't believe what he heard and at first thought someone was playing a trick on him.

The inventor was awarded a patent for his idea and brought it to JS&A. We took the idea and our engineers produced a very sensitive yet powerful AM/FM multiplex radio called the Bone Fone.

The entire battery-powered system is self-contained and uses four integrated circuits and two ceramic filters for high station selectivity. The Bone Fone weighs only 15 ounces, so when worn over your shoulders, the weight is not even a factor.

BUILT TO TAKE IT

The Bone Fone was built to take abuse. The large 70 millimeter speakers are protected in flexible water and crush resistant cases. The case that houses the radio itself is made of rugged ABS plastic with a special reinforcement system. We knew that the Bone Fone stereo may take a great deal of abuse so we designed it with the quality needed to withstand the worst treatment.

The Bone Fone stereo is covered with a sleeve made of Lycra Spandex—the same material used to make expensive swim suits, so it's easily washable. You simply remove the sleeve, dip it in soapy water, rinse and let the sleeve dry. It's just that easy. The entire system is also protected against damage from moisture and sweat making it ideal for jogging or bicycling.

The sleeve comes in brilliant Bone Fone blue—a color designed especially for the system. An optional set of four sleeves in orange, red, green and black is also available for \$10. You can design your own sleeve using the pattern supplied free with the optional kit.

YOUR OWN SPACE

Several people could be in a car, each tuned to his own program or bring the Bone Fone to a ball game for the play by play. Cyclists,

joggers, roller skaters, sports fans, golfers, housewives, executives—everybody can find a use for the Bone Fone. It's the perfect gift.

Why not order one on our free trial program and let your entire family try it out? Use it outdoors, while you drive, at ball games or while you golf, jog or walk the dog. But most important—compare the Bone Fone with your expensive home stereo system. Only then will you fully appreciate the major breakthrough this product represents.

GET ONE SOON

To order your Bone Fone, simply send your check or money order for **\$69.95** plus \$2.50 postage and handling to the address shown below. (Illinois residents add 5% sales tax.) Credit card buyers may call our toll-free number below. Add \$10 if you wish to also receive the accessory pack of four additional sleeves.

We'll send you the entire Bone Fone stereo complete with four AA cell batteries, instructions, and 90-day limited warranty including our prompt service-by-mail address.

When you receive your unit, use it for two weeks. Take it with you to work, or wear it in your car. Take walks with it, ride your bicycle or roller skate with it. Let your friends try it out. If after our two-week free trial, you do not feel that the Bone Fone is the incredible stereo experience we've described, return it for a prompt and courteous refund, including your \$2.50 postage and handling. You can't lose and you'll be the first to discover the greatest new space-age audio product of the year.

Discover the freedom, enjoyment, and quality of the first major breakthrough in portable entertainment since the transistor radio. Order a Bone Fone stereo at no obligation, today.

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SCIENCE WORLDWIDE



Extra landing light on FAA plane illuminates rear engine during flights in rain. Camera (above, right) inside the plane photographs the buildup of water near the jet intake.

The wet-jet study

Researchers from the Federal Aviation Administration (FAA) are chasing rainstorms with a 727 to test the effect of water ingestion on engine performance.

The FAA's National Aviation Facilities Experimental Center is flying wet routes under clouds to see if regulations set in the 1960s are adequate for rainy-weather safety today. "Let's face it," said William R. Westfield of the FAA. "We're operating a pretty sophisticated kind of technology now, and the standards we apply against these engines are pretty old."

The study was not undertaken because of any specific accident, Westfield told PM, although water ingestion has caused a number of crashes involving military planes. And in 1977, a commercial Southern Airways DC 9-31 crashed while trying to land on a Georgia highway after both engines lost power. U.S. investigators blamed the engine damage on "the ingestion of massive amounts of water and hail" from a severe thunderstorm. Seventy persons died.

Westfield said the experimental plane was strenuously avoiding thunderstorms and seeking out areas of moderate rain. The 727 is equipped with a bright white landing light aimed at one of the rear en-

gines and a movie camera to photograph the engine through a prism. The research may lead to an upgrading of a regulation that commercial jet engines must be able to operate on airflows containing 4 percent by weight of water during takeoff and landing approach.

Vitamin A versus radiation

Research with mice indicates that a dose of vitamin A some 10 times the minimum daily requirement inhibits the toxic effects of radiation.

For about a year, Prof. Eli Seifter of the Albert Einstein College of Medicine has been exposing mice to high doses of X-ray radiation. The exposure is similar, he said, to the kind of dose given humans to destroy cancerous tumors. Such radiation kills some normal tissue as well and can lead to a loss of infection-fighting white cells and to system-wide sickness described by some patients as a "living death." The vitamin therapy, Seifter told us, stimulates healthy parts of the body to produce more white blood cells. And that helps overcome the radiation sickness.

Seifter said it was too early to suggest use of the vitamin for human cancer patients in therapy. For one thing, the vitamin might reduce the effectiveness of the radiation in killing cancerous tissue. And further

work is needed, he said, before it will be known whether vitamin A can counter the effect of whole-body radiation that could follow a nuclear explosion or accident.

Will Halley's Comet fizzle?

First, NASA's hopes of sending an unmanned probe to Halley's Comet faded when federal budget makers turned off the funds. Now, a Purdue University professor of astronomy predicts that Earth-bound observers expecting a light show when the comet arrives in 1986 may be disappointed.

Prof. Miriam Jaffe suggests that the relative positions of the comet, Earth and sun will reduce the comet's glitter. Halley's will be brightest when closest to the sun on Feb. 9, 1986. But Earth will be far away then, on the opposite side of the sun. So chances are the comet may rank with the much-oversold Comet Kohoutek, which failed to dazzle sky watchers who were on the lookout for it in 1973 and 1974.

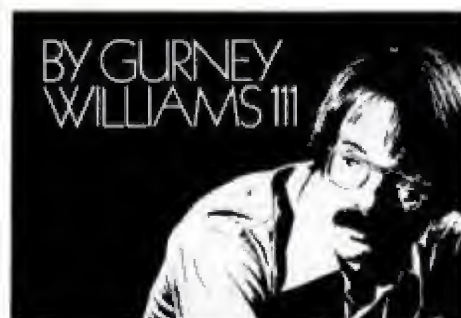
Accelerator alchemy

Some California scientists have converted bismuth metal into gold by bombarding 2-inch-square targets with particles traveling near the speed of light.

Researchers at Lawrence Berkeley Laboratory accelerated highly charged atomic nuclei of argon and neon around a ring about 100 yards in diameter. After several million circuits, the charged nuclei reached speeds up to 95 percent of the speed of light.

Then researchers aimed the nuclei at the bismuth, where the high-speed projectiles knocked out enough protons to create several million atoms of gold. The work fell somewhat short of fulfilling the dreams of medieval alchemists: One researcher, Dr. David Morrissey, told us it took some 10 hours to make gold worth about one billionth of a cent.

PM



Burglar Alarm Breakthrough

A new computerized burglar alarm requires no installation and protects your home or business like a thousand dollar professional system.



The Midex security computer looks like a handsome stereo system component and measures only 4"x 10½"x 7."

It's a security system computer. You can now protect everything—windows, doors, walls, ceilings and floors with a near fail-safe system so advanced that it doesn't require installation.

The Midex 55 is a new motion-sensing computer. Switch it on and you place a harmless invisible energy beam through more than 5,000 cubic feet in your home. Whenever this beam detects motion, it sends a signal to the computer which interprets the cause of the motion and triggers an extremely loud alarm.

The system's alarm is so loud that it can cause pain—loud enough to drive an intruder out of your home before anything is stolen or destroyed and loud enough to alert neighbors to call the police.



The powerful optional blast horns can also be placed outside your home or office to warn your neighbors.

Unlike the complex and expensive commercial alarms that require sensors wired into every door or window, the Midex requires no sensors nor any other additional equipment other than your stereo speakers or an optional pair of blast horns. Its beam actually penetrates walls to set up an electronic barrier against intrusion.

NO MORE FALSE ALARMS

The Midex is not triggered by noise, sound, temperature or humidity—just motion—and since a computer interprets the nature of the motion, the chances of a false alarm are very remote.

An experienced burglar can disarm an expensive security system or break into a home or office through a wall. Using a Midex system there is no way a burglar can penetrate the protection beam without triggering the loud alarm. Even if the burglar cuts off your power, the four-hour rechargeable battery pack will keep your unit triggered, ready to sense motion and sound an alarm.

ARRIVE HOME SAFE

There's personal danger in arriving home and finding a burglary in progress. And, if you surprise the burglar, you risk the chance of serious injury. With the Midex 55 protecting your home, you can open your front door with the confidence of knowing that no burglar lurks inside.

When the Midex senses an intruder, it remains silent for 20 seconds. It then sounds the alarm until the burglar leaves. One minute

after the burglar leaves, the alarm shuts off and resets, once again ready to do its job. This shut-off feature, not found on many expensive systems, means that your alarm won't go wailing all night long while you're away. When your neighbors hear it, they'll know positively that there's trouble.

PROFESSIONAL SYSTEM

Midex is portable so it can be placed anywhere in your home. You simply connect it to your stereo speakers or attach the two optional blast horns.

Operating the Midex is as easy as its installation. To arm the unit, you remove a specially coded key. You now have 30 seconds to leave your premises. When you return, you enter and insert your key to disarm the unit. You have 20 seconds to do that. Each key is registered with Midex, and that number is kept in their vault should you ever need a duplicate. Three keys are supplied with each unit.

As an extra security measure, you can leave your unit on at night and place an optional panic button by your bed. But with all its optional features, the Midex system is complete, designed to protect you, your home and property just as it arrives in its well-protected carton.

The Midex 55 system is the latest electronic breakthrough by Solfan Systems, Inc.—a company that specializes in sophisticated professional security systems for banks and high security areas. JS&A first became acquainted with Midex after we were burglarized. At the time we owned an excellent security system, but the burglars went through a wall that could not have been protected by sensors. We then installed over \$5,000 worth of the Midex commercial equipment in our warehouse. When Solfan Systems announced their intentions to market their units to consumers, we immediately offered our services.

COMPARED AGAINST OTHERS

In a recent issue of a leading consumer publication, there was a complete article written on the tests given security devices which were purchased in New York. The Midex 55 is not available in New York stores, but had it been compared, it would have been rated tops in space protection and protection against false alarms—two of the top criteria used to evaluate these systems. Don't be confused. There is no system under \$1,000 that provides you with the same protection.

YOU JUDGE THE QUALITY

Will the Midex system ever fail? No product is perfect, but judge for yourself. All components used in the Midex system are of aerospace quality and of such high reliability that they pass the military standard 883 for thermal shock and burn-in. In short, they go through the same rugged tests and controls used on components in manned spaceships.

Each component is first tested at extreme

tolerances and then retested after assembly. The entire system is then put under full electrical loads at 150 degrees Fahrenheit for an entire week. If there is a defect, these tests will cause it to surface.

PEOPLE LIKE THE SYSTEM

Wally Schirra, a scientist and former astronaut, says this about the Midex 55. "I know of no system that is as easy to use and provides such solid protection to the homeowner as the Midex. I would strongly recommend it to anyone. I am more than pleased with my unit."

Many more people can attest to the quality of this system, but the true test is how it performs in your home or office. That is why we provide a one month trial period. We give you the opportunity to see how fail-safe and easy to operate the Midex system is and how thoroughly it protects you and your loved ones.

Use the Midex for protection while you sleep and to protect your home while you're away or on vacation. Then after 30 days, if you're not convinced that the Midex is nearly fail-safe, easy to use, and can provide you with a security system that you can trust, return your unit and we'll be happy to send you a prompt and courteous refund. There is absolutely no obligation. JS&A has been serving the consumer for over a decade—further assurance that your investment is well protected.

To order your system, simply send your check in the amount of **\$199.95** (Illinois residents add 5% sales tax) to the address shown below. Credit card buyers may call our toll-free number below. There are no postage and handling charges. By return mail you will receive your system complete with all connections, easy to understand instructions and a one year limited warranty. If you do not have stereo speakers, you may order the optional blast horns at **\$39.95** each, and we recommend the purchase of two.

With the Midex 55, JS&A brings you: 1) A system built with such high quality that it complies with the same strict government standards used in the space program. 2) A system so advanced that it uses a computer to determine unauthorized entry, and 3) A way to buy the system, in complete confidence, without even being penalized for postage and handling charges if it's not exactly what you want. We couldn't provide you with a better opportunity to own a security system than right now.

Space-age technology has produced the ultimate personal security computer. Order your Midex 55 at no obligation, today.

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NOTES FROM THE EDITOR

John A. Litterer

Readers who are ham radio operators perhaps know PM's Electronics Editor better by his call letters, WB2KQI, than they know him by name. Around the office, though, he's just plain Neil Shapiro, despite the fact he mostly speaks computerese. He reverts to basic English to explain to the rest of us such mysteries as the first component-assembled word processor to be printed in a consumer magazine. It's really very simple, as you'll see in *PM Designs Your Personal Word Processor* on page 78. (For now, if you don't know what a word processor is, call it a super typewriter.)



Just call him WB2KQI.

Just to prove that his word processor works, Neil is well along with a 50,000-word novel on it. A medieval fantasy, it is his third book.

In addition, Neil has also invented a computer game, *Bomb Threat*, that you'll soon be able to get as a floppy disc or cassette and use on an Apple II computer. It's being produced by Programma International.

Test (in collaborazione con *Popular Mechanics*) is the newest foreign-language affiliate of PM. It began publishing in Rome in March 1979 under the direction of Mrs. Adelina Tattilo, publisher. The magazine has already distinguished itself by winning two Premio Glaxo awards. One went to the editor, Giulio Raiola, for new editorial initiatives, and a second to writer Riccardo Romani for two articles that appeared in *Test*. The award is given to outstanding European scientists and journalists in a program that's sponsored by the Union of Italian Scientific Journalists.



A prizewinner.



Well, you just can't win 'em all.

Somehow, the immortal lines penned by Robert Burns about the best-laid plans come to mind every time we look at this handsome four-color engraver's proof. We had scheduled the Olympics broadcast story for April... then May... then June. Now it's July, and, sorry, this is all you'll see of it. **PM**

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Supercar



Bulldog is Aston Martin's idea of the ultimate road car.

If you can count to 10, you qualify as official timer for zero-to-100-mph acceleration runs of the Bulldog. That's how many seconds it takes for this street-machine project of Aston Martin Lagonda to rocket through the 100-mph mark on its way to a top speed of almost 200 mph. Sure it's crazy. But at a time when every other automaker is devoting all its effort to producing the ultimate economy car, it's nice to see one company indulging itself in a search for the ultimate in performance. Aston Martin modified its 5340-cc V8 to accept twin Garrett AiResearch turbochargers and mounted the powerplant amidships in the two-seater, which is knee-high to a grasshopper. That's exactly 37 inches from its Pirelli footprints to the gull-wing door hinges in the roof.

The aluminum-bodied Bulldog isn't for sale and likely will remain one of a kind. It's purely a research and development project for the company, whose production of models like the *Volante convertible* (see *Car Care Guide*, page 139, May '80) and four-door Lagonda totals 265 handbuilt cars a year.

Superkart

That's not a 130-mph, sit-down, drive-around chain saw. The portable power people are goin' racing. Homelite is sponsoring a Superkart racing team, the first such sponsorship by a U.S. corporation. Its super-

kart is being driven by John Gibson, who is slated to run all the races on the 1980 World Karting Assn. schedule. The Superkart class, long popular in Europe, is for the most sophisticated of all karts. They're powered by 250-cc, two-cycle engines with six-speed transmissions and easily top 100 mph. And when you're driving inches from the ground, 100 mph is f-a-s-t!

Future shape



Station-wagon version of new VW Dasher.

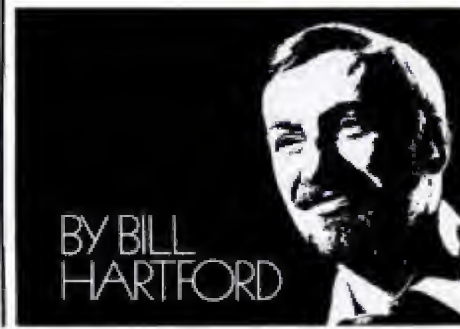
Remember when the VW Dasher was introduced? It was 1974 and in PM we called it the "future shape for the family car" (page 168, Feb. '74). That was over six years ago, and only now is Detroit fully in transition—a terribly painful one—to the production of cars more like the front-wheel-drive Dasher. The family-size VW was under \$4000 at its introduction and gave economy in the 25- to 30-mpg range. Now, with its diesel option, it gets a lot more mpg: 36 city, 49 highway, with manual transmission.

And, as a consequence of some evolutionary styling changes, it looks a lot better. Another round of sheet-metal shaping is in the works, as this photo from Europe shows. The nose is more tapered and VW's

(Please turn to page 22)



Superkart racing team is being sponsored by Homelite with John Gibson at the wheel.



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IMPORTS & MOTORSPORTS

(Continued from page 20)

emphasis on improved aerodynamics for even better mpg is obvious.

Saab story

Importation of the Saab 96 to the United States stopped in 1974, so we haven't kept up with the changes made to this strange little car, which has always been more popular in Europe than here. The V4-powered 1980 model is smooth as a teardrop and rather appealing, we think. But, alas, it's the last of the line: Production has stopped after 730,607 cars and 30 years. It was 1949 when the first Saab car, Model 92, forerunner of the 96, went on sale. Incidentally, Model 91, from the Svenska Aeroplan Aktiebolaget (Swedish Aircraft Corp.), wasn't a car at all, but a single-engine trainer. Saab will now concentrate on production of its 900 series, the Turbo models of which will get an innovation for 1981: The company has developed a way for its



1980 Saab 96 V4 is the last of the line.

turbo engine to burn fuel of any octane from 91 to 99 RON. The Automatic Performance Control system (APC), as it's called, also increases fuel economy and acceleration, and patents are applied for. Saab-Scania may not be a huge automaker (less than 100,000 annual production), but it's a dynamic one.

Stop the presses!

It happens annually, and it's one of the few times each year that all work stops in the PM Auto Dept: the arrival of *World Cars*. Last month, when the 1980 volume landed with a heavy thud on my desk, the topic of conversation in the office was about cars that are not sold in the United States and how they

might be accepted if they were. We learned from *World Cars 1980* that the lowest-priced car is a Suzuki for \$1950, but unavailable here. This 440-page book is \$33.95 in bookstores, or from Herald Books, Box 17, Pelham, N.Y.

Herald Books has a top car reference. 10803.

PM

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DAK manufactures a cassette that you can really forget about. Great sound, and no problems. And, for only \$5 we hope you will think a lot about your new LCD digital quartz watch.

YOUR TIME IS PRECIOUS

Imagine yourself just finishing recording the second side of a 90 minute cassette and horrors, the cassette jams. Tape is wound around the capstan, your recorder may be damaged and you've just wasted 90 minutes of your time and perhaps lost a great recording off FM.

Enter DAK. We manufacture over one million units of cassette tape each month in our North Hollywood factory. Many of our tapes are used for high speed duplication where they are recorded at speeds up to 8 times normal. This is the ultimate stress for cassettes and causes more failures than any other use.

MOLYSULFIDE

We developed polyester slip sheets with raised spring loaded ridges to guide each layer of tape as it winds. We coat them with a unique formulation of Graphite and a new chemical, molysulfide.

Molysulfide reduces friction several times better than graphite and allows the tape to move more freely within the cassette. The molysulfide is tougher and makes the liner more resistant to wear. Evidently 3M and TDK were hot on our heels, because they have now also come out with new liners.

Hi frequency protection! Tape is basically plastic, and as it moves within the cassette friction causes the build up of static electricity, much as rubbing a balloon against your hair, or scuffing your shoes on a carpet in dry weather.

Static electricity within the cassette is drastically reduced by the low friction of the molysulfide so that its tendency to erase very high frequencies is drastically reduced. A very important consideration for often played tapes.

MAXELL IS BETTER

Yes, honestly, if you own a \$1000 cassette deck like a Nakamichi, the frequency responses of Maxell UDXL or TDK SA are superior and you just might be able to hear the difference.

DAK ML has a frequency response that is flat from 40cps to 14,500cps

±3db. Virtually all cassette recorders priced under \$600 are flat ±3db from 40cps to about 12,500cps, so we have over 2000cps to spare, and you'll probably never notice the difference.

No apology. We feel that we have equaled or exceeded the mechanical reliability of virtually all cassettes and offer one of the best frequency responses in the industry. Maxell UDXL is truly the Rolls Royce of the industry, and DAK is comparable to the 100% US made Cadillac or Corvette!

Price DAK manufactures the tape we sell. You avoid paying the wholesaler and retailer profits. While Maxell UDXL 90s may sell for \$3.50 to \$4.50 each at retail, DAK ML90s sell factory direct to you for only \$2.19 each complete with deluxe boxes and index insert cards.



A \$5 LCD WATCH?

Of course not! This is an incredible offer. Countless stores throughout the country sell LCD quartz crystal watches like this for up to \$69.

This beautifully styled slim silvertone watch is loaded with features. LCD means that the time in hours and minutes always shows without having to push buttons. Push the button once, and you'll see the date in months and days, and push the button again and the watch shows seconds.

Night light. Usually only found in the most expensive watches. Simply push a button and the entire time section lights up for convenient night viewing.

Quartz crystal accuracy means constant time within 1 minute per month. Crystals use little electricity, so the battery should last up to a year, and may be easily changed by any jeweler. Stainless steel band for long life and

comfort. No cheap imitation, a first rate locking adjustable band.

It's guaranteed. This fine watch comes with a manufacturer's limited warranty for one full year.



DAK TAKES A RISK

Obviously giving away quality watches is not going to make DAK rich. Even giving away cheap watches wouldn't help. We are betting that you will buy our cassettes again, and we are putting our money where our mouth is!

Customers like you are very valuable in the form of future business. We anticipate receiving over 6000 orders and 4500 repeat customers from this advertisement to add to our list of over 57,000 actives.

TRY DAK ML90 CASSETTES FREE

Try these high energy cassettes on your own recorder without obligation for 30 days. If you aren't 100% satisfied for any reason, simply return the tapes and the watch to DAK for a full refund.

To order your 10 DAK ML 90 minute high energy cassettes at \$2.19 each and the \$69 value watch with your credit card, simply call the toll free number below, or send your check for \$21.90 plus \$5 for the watch and \$3 for postage and handling for each group of 10 cassettes and each watch to DAK. (Calif. residents add 6% sales tax)

DAK unconditionally guarantees all DAK cassettes for one year against any defects in material or workmanship.

Why not order an extra group of 10 DAK ML90 cassettes for yourself or a friend? We will add one free ML90 cassette to each 10 you buy and of course you can buy one \$69 value watch for \$5 with each group you buy.

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Coming: Big-screen TV by laser

Automated assembly techniques are now making TVs more quality-controlled than ever. Chassis are getting smaller and smaller, pictures bigger, and there's a laser projection TV on the horizon.

by Stan Prentiss

The video revolution begins this year with the introduction of videodiscs from Magnavox, RCA, Pioneer and others, as well as a huge assortment of video cassette recorders. Then there is wideband (4 MHz) television, which offers improved color and resolution on all TVs.

Next year we should see more improved projection setups, along with additional all-band tuners. In 1982, we can look forward to stereo TV sound, more discs/cassettes, and international TV receivers. By 1983, circular polarization and electronic ghost canceling may make pictures clearer than ever. Direct satellite-to-home broadcasting may be here by 1984, available for a monthly toll similar to cable-TV setups today. Cable-TV will also expand.

Wideband TV and videodiscs

Full-detail viewing of 330 lines of horizontal resolution, introduced by Magnavox in 1978 and also offered by RCA and others this year, will result in picture sharpness unavailable on ordinary 200- to 240-line color sets.

The laser-beam videodisc was originated by N.V. Philips of the Netherlands. Sold in this country by Philips' subsidiary, Magnavox, it will continue as the disc mainstay until at least the first quarter of 1981, when RCA and its stylus-capacitance contact system is ready for market. And although RCA says its constant-speed unit will be several hundred dollars cheaper, advantages of stop, start, eventual indexing and the nonwearing properties of the laser beam will sell many Philips-type systems before April or May of 1981. Pioneer, which already has an industrial disc like Philips', with indexing, is available now.

Big-screen, all-channel TV

Projection receivers and all-channel tuning are separate entities, but

(Please turn to page 26)

TOMORROW'S BRIGHT, BIG PICTURE—VIA LASER

The laser projection TV we picture here doesn't exist—yet. But the concept is an exciting one that should become available at the consumer level before 1990.

The big problem with the big-picture TVs today is that pictures are not as bright and viewable as on the average 25-inch TV. Using lasers could overcome this problem.

Today's projection TVs have triple picture tube and lens arrangements. Each of these tubes projects red, green or blue light that is combined on the screen into lifelike color.

From what we know of prototypes, laser TVs will feature red, green and blue lasers. This will necessitate many changes.

A normal picture tube contains an electron gun that shoots out an electron stream. These electrons hit the face of the picture tube and cause chemicals to phosphoresce brightly, so we can see a picture.

To cover the screen, the beam must move

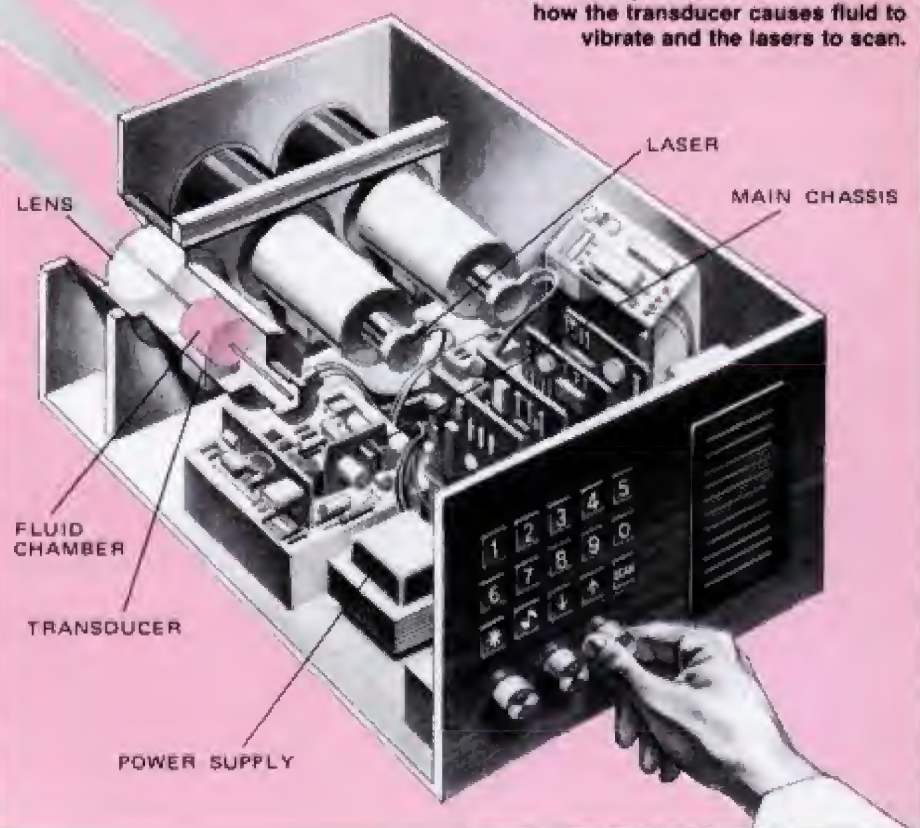
about—or scan. Normally, this is done by magnetically attracting the charged electron beam and thus deflecting it back and forth. But laser light is not affected by magnetism. How to make the lasers scan?

Zenith, back in '66, solved this problem ingeniously. It used a fluid-filled chamber in front of each laser, along with ultrasonic transducers (see picture). The transducers cause the fluid that the laser passes through to act as a vibrating, controllably deformable lens. By varying the output of the transducer, the laser can be made to scan.

Though the original Zenith prototype only had a 3-MHz video signal (very low contrast), the system could be improved.

Other things we envision include taking advantage of the new, smaller TV chassis for a compact cabinet and the possibility that there might even be stereo in the laser set.—Neil Shapiro

Artist's conception of a laser TV shows how the transducer causes fluid to vibrate and the lasers to scan.



World's First and Only Solar-Powered Watch*

Guaranteed to outperform any watch sold today... or costs you nothing!

The Sunwatch; acclaimed as the most accurate, most versatile, most rugged watch ever made.

These features make all other watches obsolete:

- Only watch with a natural side-view window simplifies reading
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- No resetting of calendar, not even in leap years

Space age accuracy

Now you'll never worry about accuracy again. Because the Sunwatch will keep you on time for the rest of your life. (Accurate to within 1 sec. per month.)

Solar age efficiency

Miniature solar cells automatically convert sunlight, daylight or ordinary bulb light into usable energy for storage. The solar cells last virtually forever. So you'll never replace a watch battery again.

Programmed for over a century

The built-in computer on a chip will always display the correct time date and month. Also, it automatically adjusts the watch calendar for long and short months, leap years and it's programmed until the year 2100!

Easy to read

The natural side-view display lets you tell the time, day and date without twisting your arm into an uncomfortable position.

Numbers always visible

Four varying light intensities are built into the viewing display, allowing the Sunwatch to adjust automatically to any light. This means you can always read it, even in the brightest sunlight.

10 Display functions

The Sunwatch is capable of displaying the following information: hours • minutes • seconds • months • date • day • leap year • speed calibration • AM/PM indicator • seconds count-off.

Extreme accuracy

Unlike other electronic watches using tuned crystals to control timing accuracy, the Sunwatch incorporates a unique, programmable, microcircuit synthesizer to make it the first watch in history that is accurate to less than 1 second per month. That's 5 times more accurate than the latest quartz Accutron.

The Power Source

Tiny silicon power cells, which are constantly being energized by natural sunlight, daylight or an ordinary light bulb keep the Sunwatch energy storage system charged. Should the watch not be exposed to light, it will continue to operate for months on stored power.

The most indestructible watch in the world
The workings of the watch: solar panels, energy coils, quartz crystal, computer on a chip, etc., are all permanently sealed in a Laxan module. This module is so unique it's protected by U.S. and foreign patents.

Completely waterproof

Leave the Sunwatch in salt water for months. Dive with it in depths up to 750 feet. There are no openings—magnetic slide bars activate all functions. With Sunwatch's exclusive, permanently sealed Laxan module, there are no "O" rings or seals to leak.



Shock resistant to 25,000 G's

You can crash it into a rug-surfaced brick wall at 90 mph with no noticeable effect. Wear it while doing heavy work, exercise or any strenuous activity.

Temperature resistant

Put the Sunwatch in boiling water for 30 minutes, freeze it in a block of ice for a year. Extreme temperatures will not damage your Sunwatch.

Pressure resistant

There are no air spaces inside the Sunwatch. Therefore, it is not susceptible to high pressures such as might be encountered diving to great depths.

The perfect watch for a lifetime

Imagine split-second accuracy for the rest of your life. Sunwatch is a virtually indestructible, beautifully styled, space-age timepiece, and it's available in three exciting finishes: Brushed stainless steel, Gold tone stainless steel, or a Durable black finish on stainless steel. All Sunwatches come with a matching stainless steel band with removable links and adjustable clasp.

Made in the United States

The Sunwatch, designed by Roger Riehl, was being worn by its inventor nearly a year before the first electronic digital watch was even available to the general public. Since that time constant engineering evaluations and design improvements have been made on the Sunwatch to incorporate the latest in digital microcircuit and solar power technology. Thus the Sunwatch today represents state-of-the-art electronics technology. It is built to the same rigid standards practiced by the manufacturer in creating sophisticated computer microcircuits for the U.S. Government and other major users of these components.

* A word about other "Solar Watches"

Roger Riehl, designer of the Sunwatch, states that there is no other completely solar powered watch on the market today. Claims of solar power by other watch manufacturers are based on the use of a small solar cell. Due to their limited size, these cells can be proven, in technical terms, to be of virtually no significant value in extending the life of a watch battery. For this reason, all other so-called "solar watches" must have replaceable batteries. The Sunwatch's power storage system, however, need never be changed and is, in fact, permanently sealed to withstand abuse and the elements.

Unique and memorable gift

Available in a special gift box (see order form) the Sunwatch makes an ideal gift for special holidays, birthdays, graduation, Father's Day, etc. Perfect for business people, commuters, teachers, athletes and sportsmen, who require split second accuracy.

Free custom engraving

At your request, each Sunwatch will be hand-engraved with the name you specify.

Limited Warranty is your protection

The Sunwatch is covered by a 2 year limited warranty issued by Riehl Time Corporation (manufacturers of the prestigious Synchroner 2100) and included with your watch. A copy of the warranty may also be obtained free of charge by writing to Riehl Time Corp., 53 S. Jefferson Rd., Whippany, NJ 07981. This warranty gives you specific legal rights, and you may have other rights which vary from state to state.

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Order your Sunwatch today and use it for 15 days. Then, if you are not completely satisfied return it for full money back.

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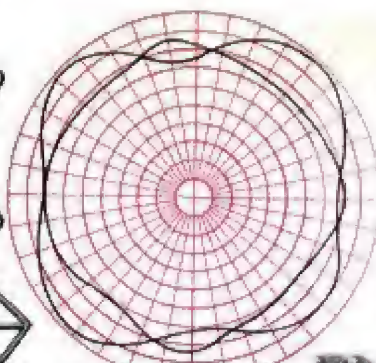
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City/State/Zip _____

Quick delivery direct from the manufacturer



A circularly polarized antenna (CP) has both vertical and horizontal elements. This helps to cancel ghosts which can be caused by signal echoes in one of the planes. If received on a CP at-home antenna, the signal gains in relative strength. Pattern (top) demonstrates a similar type of radiation.

New machine, installed in RCA's Indiana assembly plant, brings new automation techniques to TV chassis alignments (right). The new chassis the machine aligns (bottom) is 10 x 11 inches and has 40 percent fewer parts than predecessors.



BIG-SCREEN TV BY LASER

(Continued from page 24)

both are being developed into highly desirable products simultaneously. Roger Howe and Brian Welham of U.S. Precision Lens predict vastly improved home projection systems in the next two years. They forecast that if U.S. sales of television continues at a 10-million-per-year rate, projection TV will have some 5 percent of that output, or 500,000 receivers, by 1983. Prices, they say, should range from \$2000 for the usual front-view, one-piece (screen and chassis in one cabinet) to \$3000 for rear-screen systems.

No more fine tuning

All-electronic channel tuners—105 station positions or more—feature phase-locked loop design, with no fine tuning needed. They are capable of selecting any VHF/UHF or CATV (cable) frequency without the bother of set-top converters.

RCA is leading America's TV industry in the effort to make receiver chassis smaller, and recently announced its very new CTC 107 color chassis. It measures only 10 x 11 inches. Parts count for the new set has been reduced 40 percent. Reliability should improve at least 33 percent. RCA's goal is to reduce service calls to no more than 1-plus in 10 to 11 years.

The CTC 107 chassis manufacturing process is also fully automated, with electrical checkout conducted

(Please turn to page 140)

CCD CAMERAS—NEW SOLID-STATE TECHNOLOGY



Charge-coupled devices are for still cameras or video (above). Each (right) holds 200,000 picture elements.

Out of computer research and development has come the charge-coupled device, or CCD. The CCD promises to change the very image of TV cameras.

Solid-state video cameras are now available with CCD image sensors. Cost is high, but will likely come down. When it does, silicon CCD chips may replace bulky vidicon tubes.

Even today's, probably primitive, CCDs offer phenomenal resolution figures. Matsushita (Panasonic) has a \$15,000 black-and-white video camera with a CCD sensor that has 350 vertical lines of resolution by 360 horizontal—from 248,832 picture elements.

Solid-state design will mean compact, go-anywhere cameras. Further, maintenance should be reduced to almost nothing.

Basically, CCDs convert light into electrical signals. They then transfer this electrical energy and store it. Once stored, the energy can be processed back into a viewable form.

The CCD also uses something called "bucket-brigade" technology. Each storage cell on a CCD chip can pass its electrical charge, bucket-brigade style, to its neighbor. Images literally flow along the chip to the processor. In this way, frame after video frame can be transmitted.

Because of this solid-state design, such video cameras are free from the problem of

blooming. Blooming occurs when intense light, such as from a flame, causes streaks in the picture. CCDs can reduce blooming by a factor greater than a hundred times.

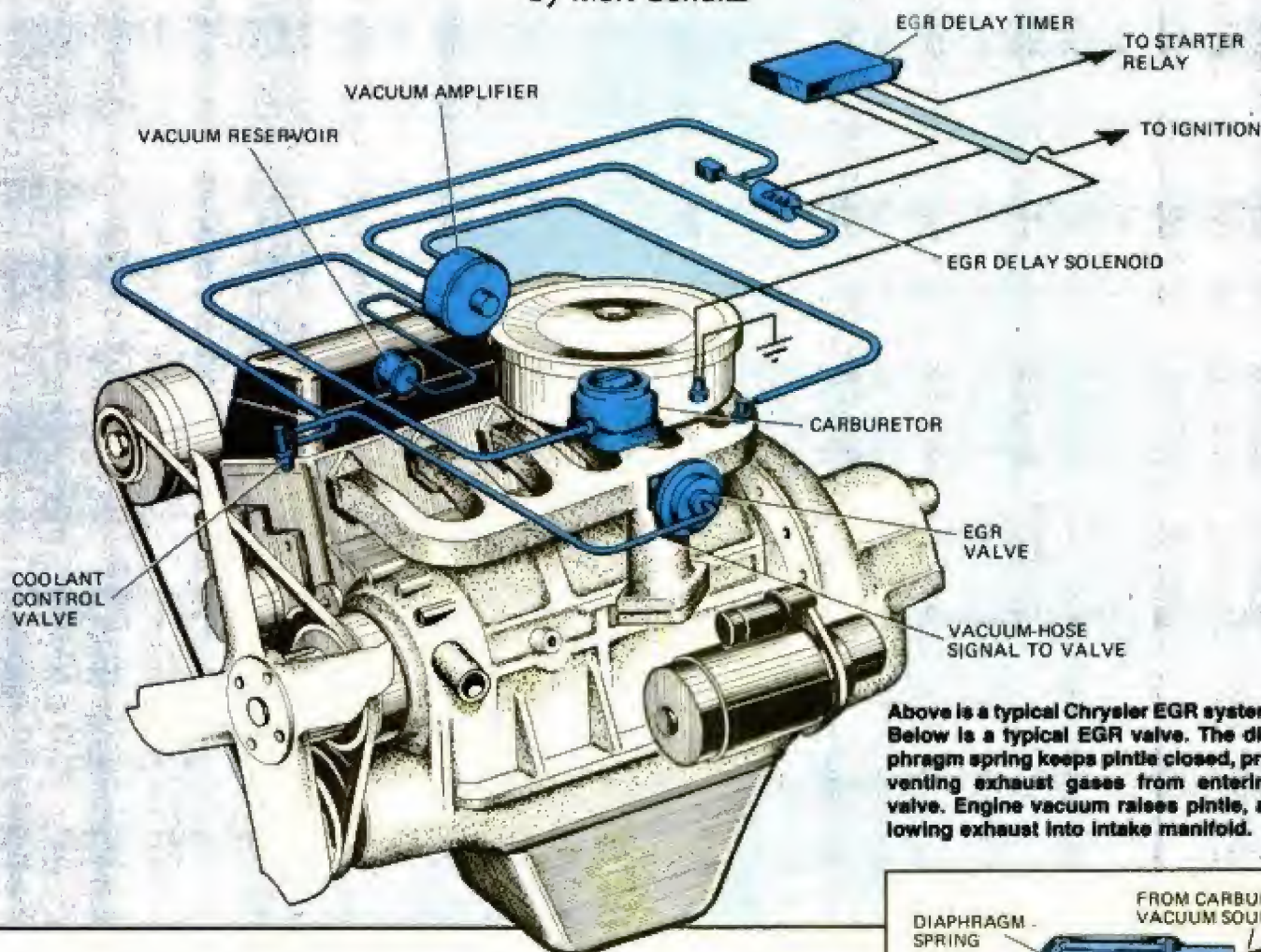
In still cameras, CCD chips will probably replace black-and-white film—in professional cameras at first. Film advance and shutter will be eliminated; fewer moving parts will reduce cost and weight considerably. And since CCDs are so sensitive, they may not even need flash in low light. Image storage is a problem. Twenty "exposures" would require greater memory capacity than is economically available today. But a cluster of 20 CCDs could be used to store information read off the image sensor. A reusable memory module could then be "developed" electronically; photos would be printed in the usual way. Laser printing (see *Now Lasers Help Make Better Color Prints from Slides*, page 54, Nov. '79) already incorporates most of the necessary technology.

Image quality is also a worry, but could be upgraded, if necessary, with already-available computer-enhancement techniques.

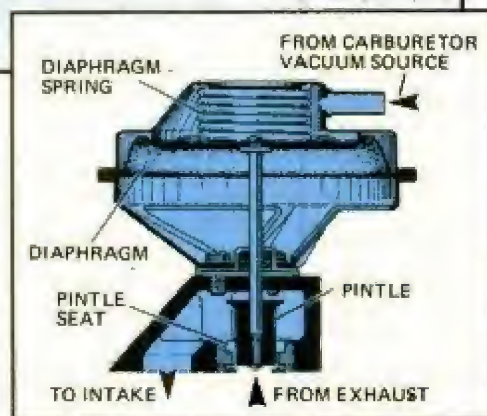
That's fine for black-and-white, but what about color? A color CCD camera would probably need at least two or three sensors. Size, memory requirements and cost would all increase. All these difficulties are solvable, however, probably sooner than anyone thinks. —N.S. and Tom Sahagian

Troubleshooting pollution-control systems

by Mort Schultz



Above is a typical Chrysler EGR system. Below is a typical EGR valve. The diaphragm spring keeps pintle closed, preventing exhaust gases from entering valve. Engine vacuum raises pintle, allowing exhaust into intake manifold.



Of the three automobile antipollution systems, the one controlling emissions from the tailpipe causes the most confusion, the greatest number of engine performance problems and the most difficulty when it comes to servicing.

The main reason for this is the variety of components that are needed to control the output of individual gases that make up exhaust. These gases are hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxides (NOx).

The other antipollution systems (closed crankcase ventilation and fuel-evaporation control) control only one polluting agent, HC. They need relatively few parts to do this. Servicing, therefore, is relatively simple (see *Troubleshooting Pollu-*

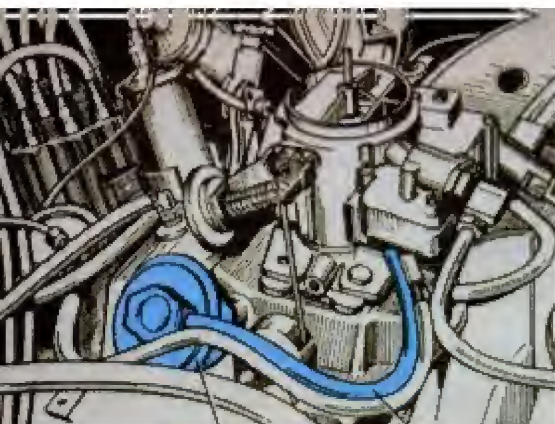
tion-Control Systems, page 43, June '80).

However, don't let me scare you. If you approach the exhaust-emissions-control system in your car armed with some know-how, you shouldn't have trouble finding a faulty component and making repairs. To this end, this article begins a discussion of the exhaust-gas-recirculation (EGR) system, which is the main exhaust-emissions control used by manufacturers since 1973.

Since EGR systems differ from one manufacturer to another, this article is split into two parts. We deal this month with the EGR systems used by American Motors, Chrysler Corp., Datsun and Ford Motor Co. In an upcoming issue, we will cover the EGR systems of Gen-

eral Motors, Honda, Toyota and Volkswagen.

Is all this emphasis necessary? We think so, because the EGR system is responsible for many performance headaches that are frequently blamed on other engine systems. Because the EGR system is usually overlooked, car owners and mechanics have spent a lot of money and a



EGR VALVE VACUUM LINE

The EGR valve usually can be located on the intake manifold, near the carburetor.

lot of time unsuccessfully trying to find the cause of the following problems:

- Rough engine idle.
- Rough engine performance during light-throttle acceleration.
- A deep sag in engine speed as the engine is accelerated, almost to a point where the engine dies. When it's cold, it may, indeed, stall.
- Engine stalling on deceleration.
- Engine detonation (pinging).

What EGR does

The EGR system helps reduce the formation of NOx during combustion. The NOx results from the high temperature of combustion. As the temperature increases, the quantity of NOx also increases.

EGR helps to control NOx by reducing combustion temperature. This is done by introducing exhaust gas into the intake manifold through a control valve to cool things down.

However, the EGR valve is not the only part of the EGR system. There are other parts that control EGR valve function. The EGR valve is located near the carburetor, attached to the intake manifold.

AMC's EGR

Note: This discussion does not include the EGR system used with the AMC feedback carburetor system, which will be covered in a future issue.

Generally, the AMC EGR system consists of the EGR valve, a coolant-temperature override (CTO) switch, and connecting hoses. Test the EGR valve as follows.

1. Warm up the engine to operating temperature. Connect a tachometer.

2. Let the engine idle and place your index finger on the EGR-valve diaphragm.

3. Have someone in the car open and close the throttle. Engine speed should reach at least 1500 rpm during acceleration.

4. You should feel the diaphragm pulsating as acceleration and decel-

eration take place. If you don't, do the following:

■ Check vacuum hoses for leaks or disconnected or loosely connected ends, and correct routing. To determine correct hose routing, consult the vehicle emission control decal, which may have a routing diagram. If not, consult the service manual. This applies to all cars we discuss.

■ Check the CTO switch.

■ Replace the EGR valve if these steps fail to solve the problem.

5. With the engine idling, depress the EGR-valve diaphragm. There should be an immediate drop in engine speed. If engine rpm doesn't change, the EGR valve may not be closing off the flow of exhaust gases to the intake manifold at idle. In this case, you should:

■ Check vacuum hoses.

■ Replace the EGR valve.

The purpose of the CTO switch is to send a vacuum signal to the EGR unit when coolant temperature reaches a particular level. The EGR then can begin to function. In some engines, this temperature is 115° F.; in others, 160° F.

If the CTO switch needs replacing, note color markings on the switch to make sure you get the correct switch for your engine. A 115° F. switch has

a black body or a dab of black paint; a 160° F. switch has a yellow body or a dab of yellow paint.

To test the CTO, proceed as follows:

1. With the engine cold, disconnect the vacuum line at the EGR valve and connect a vacuum gauge to the line.

2. Start and run the engine at about 1500 rpm. If vacuum registers on the vacuum gauge, replace the CTO switch.

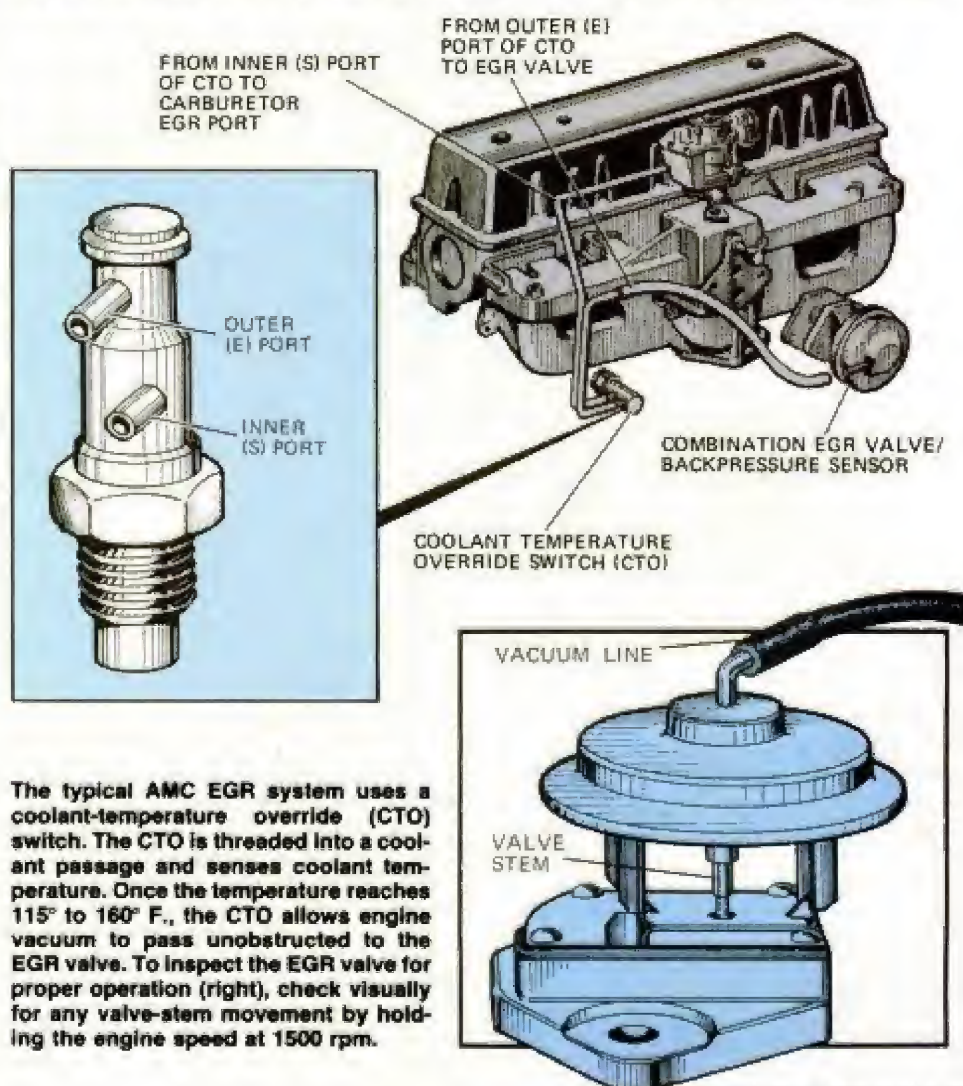
3. Let the engine warm up; then accelerate to 1500 rpm. Vacuum should register on the vacuum gauge. If there is no vacuum, replace the CTO switch.

To replace the CTO switch, drain coolant from the radiator and unscrew the switch from its seat. Install the new switch, making sure vacuum hoses are connected correctly.

Chrysler's EGR

Note: This discussion does not include the EGR system used with the Chrysler electronic feedback carburetor, which will be covered in a future issue.

If an EGR system malfunction is suspected of causing an engine performance problem, first test the



The typical AMC EGR system uses a coolant-temperature override (CTO) switch. The CTO is threaded into a coolant passage and senses coolant temperature. Once the temperature reaches 115° to 160° F., the CTO allows engine vacuum to pass unobstructed to the EGR valve. To inspect the EGR valve for proper operation (right), check visually for any valve-stem movement by holding the engine speed at 1500 rpm.

EGR valve. Connect a tachometer and warm up the engine. Then let the engine idle (transmission in NEUTRAL for about a minute.

Accelerate the engine rapidly to between 2000 and 3000 rpm. You should see EGR valve-stem movement. Repeat the procedure several times to verify movement.

If the valve stem moves, look for the cause of performance problems elsewhere. Your trouble is not EGR-related. But if a valve-stem movement isn't seen, follow this procedure to track down the malfunctioning component:

1. Check vacuum hoses for leaks or disconnected or loosely connected ends, and correct routing.

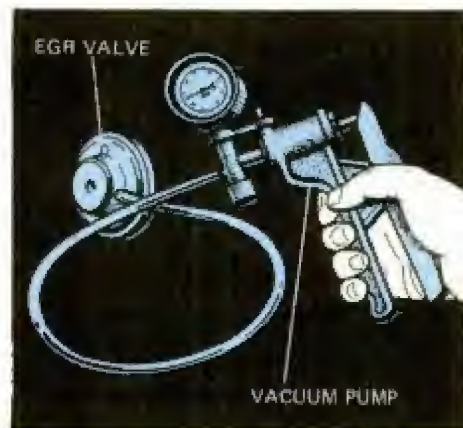
2. Disconnect the vacuum hose from the EGR valve and connect a hand vacuum pump. Apply a minimum of 10 inches Hg of vacuum. If there is no stem movement, replace the EGR valve. If the stem moves (valve opens), clamp the pump hose. The valve should stay open for at least 30 seconds. If not, the diaphragm has a hole. Replace the valve.

3. If the EGR valve is okay, check the coolant-control, exhaust-gas recirculation (CCEGR) valve. This performs the same function as the AMC CTO valve.

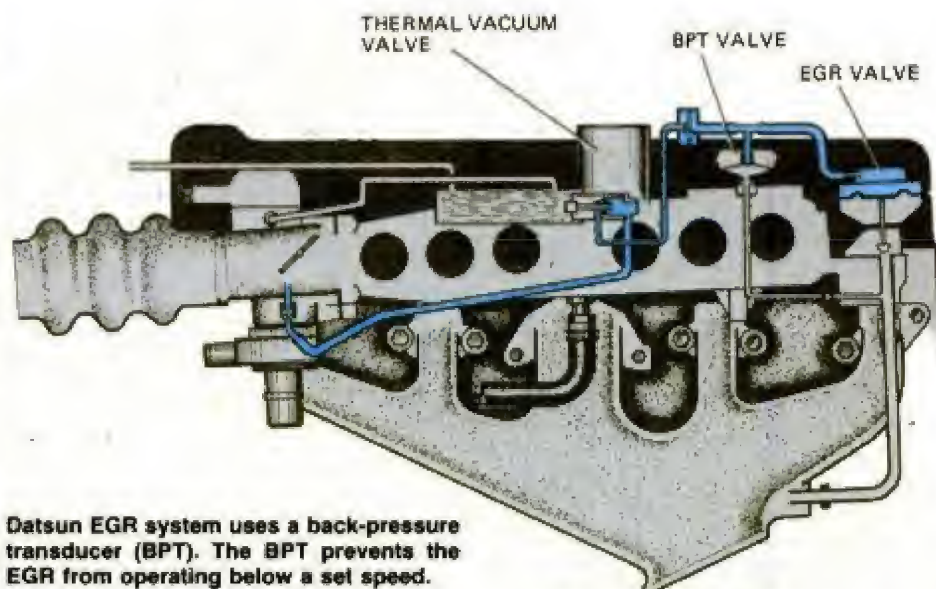
To check the CCEGR valve, bypass the valve by disconnecting the two hoses from the valve and connecting them together with a short piece of $\frac{1}{16}$ -inch tubing.

Check EGR-valve functioning as explained in Step 2. If the valve stem now moves when the engine is accelerated, drain the coolant and replace the CCEGR valve. *Note:* Some Chrysler engines have two CCEGR valves. Test both of them.

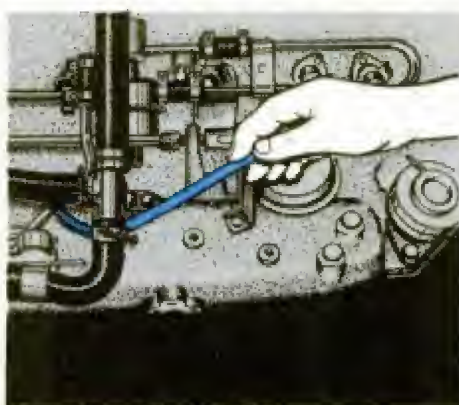
Most Chrysler engines have a venturi vacuum-control unit (vacuum amplifier) as part of the EGR system. This unit modulates the operation of the EGR system according to the load on the engine. To test this



To test an EGR valve, use a hand vacuum pump if engine vacuum fails to move stem.



Datsun EGR system uses a back-pressure transducer (BPT). The BPT prevents the EGR from operating below a set speed.



To test for engine vacuum, disconnect hose at the EGR valve and feel for suction.

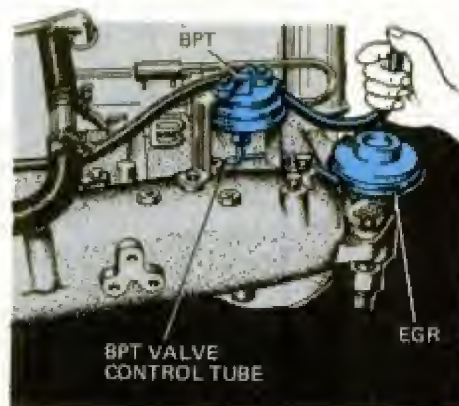
valve, trace the hose that goes from the amplifier valve to the nipple on the carburetor. Disconnect the hose at the carburetor and attach a hand vacuum pump to the end of the hose.

With the engine idling, apply about 2 inches Hg of vacuum. The engine speed should drop a minimum of 150 rpm and the EGR-valve stem should move. If this does not happen, replace the venturi vacuum control valve.

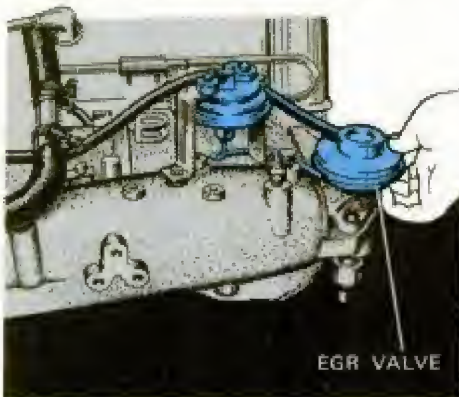
Some Chrysler engines have a delay timer and solenoid that prevent EGR operation when the engine is idling. When one of these units fails, subsequent EGR operation may cause engine stalling or sagging at idle.

To check the EGR time-delay solenoid, disconnect hoses at each end of the solenoid and connect hoses together with a short length of $\frac{1}{8}$ - or $\frac{1}{16}$ -inch tubing (whichever fits best). This bypasses the solenoid. Test the EGR valve again (Step 2).

If the valve stem now moves, reconnect solenoid hoses and disconnect the electrical plug from the solenoid. Now, if the EGR valve stem does not move, the solenoid is defective and should be replaced. If the



To test Datsun BPT valve, rev to 3500 rpm. Strong suction means good valve.



If visual inspection of valve-stem movement is impossible, check by feeling.

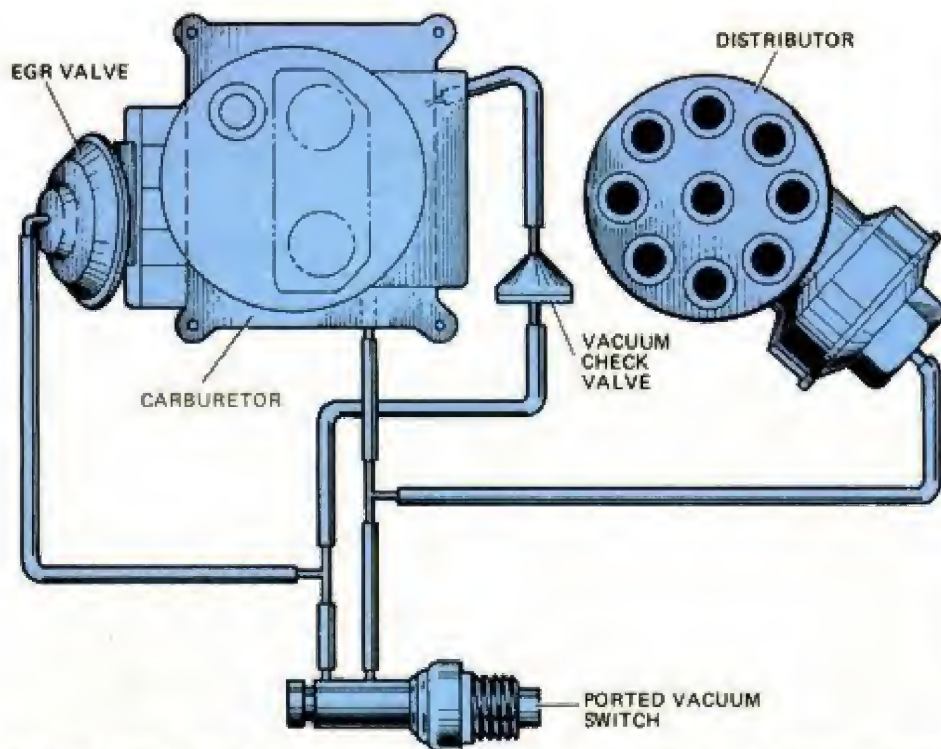
EGR valve stem does move, the EGR delay timer may be defective.

Datsun's EGR

Note: Not all Datsun engines have all parts discussed here.

Generally, the Datsun EGR system consists of an EGR valve, a thermal vacuum valve (performs same function as AMC CTO and Chrysler CCEGR valves), a BPT valve, and connecting hoses.

The purpose of the BPT valve is to control the flow of recirculated exhaust gas to the cylinders in respect to the position of the EGR-valve dia-



A typical Ford EGR system uses a ported vacuum switch (PVS). The PVS automatically adjusts and increases the idle speed and prevents the car's engine from overheating.

phragm and the state of the engine operation. For example, when exhaust pressure falls below a certain minimum, the BPT valve closes to shut off recirculated exhaust gas to the EGR valve.

Note: Many other EGR systems use back-pressure transducers. However, in most American-built cars, the BPT is inside the EGR valve.

To test the Datsun EGR system, proceed as follows:

1. Look for damaged, disconnected and incorrectly routed vacuum hoses.

2. Connect a tachometer. Start the engine, which must be cold, and disconnect the vacuum hose between the thermal vacuum and BPT valve at the BPT valve.

3. As engine speed is increased to 3000 to 3500 rpm, hold your finger over the end of the hose. There should not be a vacuum. If there is one, replace the thermal vacuum valve.

4. Allow the engine to reach normal operating temperature. Check that the thermal vacuum valve is functioning again, but this time you should feel a strong vacuum. If you don't, replace the thermal vacuum valve.

Caution: Before removing the thermal vacuum valve, drain the coolant.

5. Reconnect the vacuum hose between the thermal vacuum and BPT valves, and disconnect the hose between the BPT and EGR valves at the EGR valve.

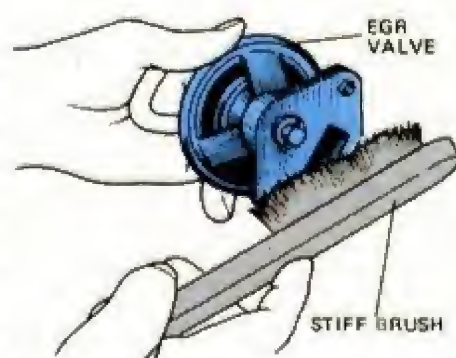
6. Hold your finger over the end of the hose as the engine speed is increased to 3000 to 3500 rpm. You should feel a strong vacuum. If you don't feel the vacuum, then replace the BPT valve.

Note: Notice that a BPT-valve control tube is connected to the underside of the BPT valve. This must be disconnected to remove the BPT valve.

7. Reconnect the BPT valve to the EGR-valve vacuum hose. Place a finger on the diaphragm of the EGR valve as the engine is accelerated to 3000 to 3500 rpm. If the diaphragm doesn't move, replace the EGR valve.

Ford's EGR

Note: This discussion does not include the EGR system used with the Ford electronic engine control system, which will be covered in a future issue.



To clean an EGR valve, use a solvent and scrub the pintle seat with a stiff brush.

Generally, the Ford EGR system consists of an EGR valve, one or two ported vacuum switches (PVS) and a vacuum-check valve. The PVS is a thermal switch that protects the engine from overheating by allowing engine-idle rpm to increase when the engine reaches a certain temperature.

To determine if the EGR system of a Ford engine is working properly, you should proceed with the following trouble shooting steps:

1. Remove the air-cleaner assembly so you can watch EGR valve performance. However, place the air cleaner in a position that prevents vacuum hoses from being disconnected, especially the one between the EGR valve and the temperature vacuum switch, which is inside and part of the thermostatic-controlled air cleaner.

2. Check vacuum hoses to be sure that they are in good, reliable, condition, connected tightly and routed correctly.

3. Warm up the engine to normal operating temperature and connect a tachometer.

4. Now, open and close the throttle slowly. Don't exceed 3000 rpm. Watch the EGR valve stem. It should move up and down as the throttle is activated and released. If this happens, the EGR system is okay. If the EGR valve stem doesn't move up and down, proceed with troubleshooting.

5. Disconnect the vacuum hose between the EGR valve and temperature vacuum switch in the air cleaner at the EGR valve. Connect a vacuum gauge to the hose and run the engine at 1200 to 1500 rpm, with the transmission in NEUTRAL. If the vacuum is less than 4 inches Hg, be certain to check the PVS and the air-cleaner temperature vacuum switch.

6. Ford uses five different ported vacuum switches. It is not possible, because of space limitations, to describe how to check each one. If a PVS switch is thought to be faulty, test the temperature vacuum switch first. If the system is in otherwise good condition, replace the PVS which appears to be most likely defective.

Test the temperature vacuum switch by verifying the operation of the thermostatic-controlled air cleaner, as we discussed in *Saturday Mechanic* in the April '80 issue (*Troubleshooting Lack of Engine Power*, page 45).

7. If vacuum at the EGR valve-to-temperature, vacuum-switch hose is determined to be okay (Step 5), reconnect the hose and replace the EGR valve.

FM

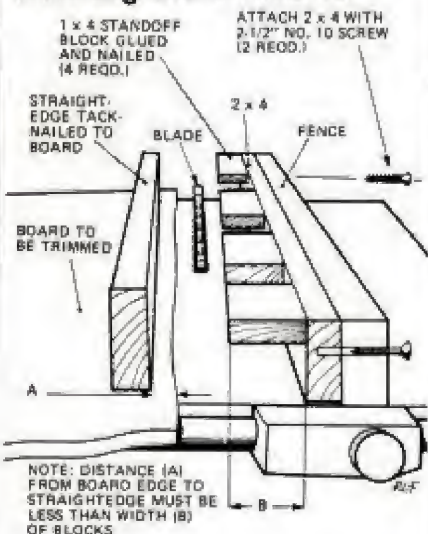
HINTS FROM READERS

Holes bored in a square



A pair of $\frac{1}{8}$ -in.-dia. holes bored through a framing square make it particularly useful in constructing frames and boxes on a workbench. You can secure the square to the workbench using $\frac{1}{2}$ -in. sheet-metal screws with pan-heads.—Howard E. Moody.

Trimming uneven boards



With this setup, you can easily square the first edge of a piece of stock having four ragged sides. Use the straight side to make the second cut, etc.—B.L. Wilson

Counterboring bolt-head holes

Quickly counterbore clean holes for bolt heads in wood using a rabbeting bit usually used in a router. First bore a hole about $\frac{1}{4}$ -in.-dia. larger than the pilot at the tip of the rabbeting bit. Then, using the rabbeting bit in a drill press or in a portable drill, counterbore to the desired depth. Enlarge the hole for the bolt to the proper diameter with a regular bit.—Harold Lewis



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A man in an orange raincoat is standing on the deck of a ship, leaning against a railing. He is smoking a cigarette. The ship's structure, including masts and rigging, is visible in the background against a blue sky. The ocean is visible in the foreground.

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HINTS FROM READERS

Improved roof coater



Worn brooms make handy spreaders.

You can make your own brush for spreading on an asphaltic roof coating. To do so, simply fasten a discarded, plastic broom head to a length of 2x4. Then, just attach a broom or 1x2 handle.—*David W. Roberts*

Filler for oversized hole

To tighten a screw in an oversized hole, coat a short length of pipe cleaner with glue and insert it into the hole to serve as filler.—*Lane Olinghouse*

Electric carver cuts foam



Use an electric knife to cut urethane foam smoothly to shape. First mark the cut line with a soft lead pencil or broad-tip felt marker. Then work slowly; open the cut by pulling away the material as you go.—*Ralph S. Wilkes*

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PM EXAMINES PRODUCTS AND SERVICES

New finish for old siding

There's good news for those who installed aluminum or steel siding 15 to 20 years ago. PPG Industries, manufacturer of PPG Paints, has introduced a new exterior finish designed expressly for aluminum and steel siding. The latex coating has



New Metal Siding Refinish can be applied by pad, spray or brush (top) to cover dull, dingy siding (above left) and make it look like new (right). It comes in exterior white and a mixable pastel base.

unique film qualities completely different from conventional latex exterior paints, according to a PPG spokesman. The paint, called Metal Siding Refinish, can withstand the expansions and contractions of metal siding and has the strength and

surface hardness to discourage mildew. It's about \$20 per gallon at paint stores or write PPG Industries, 1 Gateway Center, Pittsburgh, Pa. 15222 for supplier.—H.W.

A lock on electricity

This combination lock fits any standard 120-v. two- or three-prong electric plug. Rendering the plug inoperative, it effectively prevents unwanted hands from fooling with power tools, toasters, heaters and other potentially dangerous electrical appliances. (As a bonus, parents can lock the television power cord so



To lock a plug effectively, just insert it into the end of the device. In order to unlock and release

the plug, you must first set the combination and then push the release button.

junior will keep his nose in his books.) Lock-A-Plug comes with a five-year guarantee.

It can be purchased from the Meloworld Products Co., R.D. 1, Box 90-D, Slate Hill, N.Y. 10973 for \$6.95 postpaid.—Rosario Capotosto

Stanley's assembly line

The Stanley Assembly Line is a new type of fastener storage system that is designed to let you customize your own fastener assortment. The maker offers more than 250 varieties in 24 categories of fastening hardware



Handy cabinet holds 15 drawers, is wall-mountable, or can be kept on workbench.



Plastic boxes in which fasteners are sold feature built-in tracks, become drawers.

in convenient plastic boxes which serve as drawers. Drawers are labeled to identify contents quickly by name and size. The cabinet is sold separately for \$1.79. From Stanley Hardware, Div. of the Stanley Works, New Britain, Conn. 06050.—H.W.

Ruler guide aids marking

If you've ever been jabbed by a splinter when using your thumb as a makeshift marking gauge, you'll appreciate this new gadget. Its channel holds a folding rule, and a nylon



Pocket-sized gauge slips over a zigzag ruler to spare you from thumb splinters.

roller rides against the workpiece. Available from Knight Tool Co., Box 150, Knox, Pa. 16232, it's \$3.98 plus 50 cents shipping.—H.W.

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

ALL OUTDOORS

Fine-tuning

The outboard of the future may eventually have remote starting, steering, throttle, shift, tilt, trim—and vertical mount lifter.

Racing drivers have long known that motor adjustments are essential for top performance, and that propeller changes, lower-unit trims and mounting-height variations possible with an outboard can improve speed and/or fuel economy.

Shimming-up engine height an eighth of an inch at a time on a high-performance hull can add speed until the prop gets up where it chops air and cavitates. Test driving and examining experimental rigs recently at Mercury Marine's research and development center in Oshkosh, Wis., we noted that a number of the boats were fitted with hydraulic lines and wiring for adjusting transom height up and down from the driver's steering position while underway.

"Eventually," Merc's engineers confided, "we may see transom mount adjustments built into an outboard motor as one more remote-control feature. Not right away, but it's certainly a possibility."

Right now, almost any outboard



Recognize this as a hydroelectric transom kit? This motor height adjuster may be the answer for outboard performance.

can get more miles per gallon or speed after a little experimenting to find an ideal engine height. All you need is a speedometer and tachometer, although rough improvements can be noted on timed runs between two markers. Just raise or lower the motor, retighten mounting bolts or clamps, and time a run.

As an accessory, a hydroelectric motor-mount kit with nearly five inches of up-and-down travel is available from Land & Sea Performance Center, 360 North Broadway, North Salem, N.H. 03073. For perfectionists who can afford the \$677 price for remote adjustments of the biggest outboards, the unit boosts

speed, fuel economy and handling performance. Land & Sea also supplies outboard motor speed gear such as high-compression heads, fuel-injection systems, racing gear cases and nitrous oxide injection that squirts in as much as 75 extra hp per dose of N_2O gas.

New gear

■ The all-terrain vehicle, a product long looking for a market, is now offered as a "pickup" by Attex, 870 West Main St., East Palestine, Ohio 44413. In addition to the 2x4-ft. car-



Called an ATV pickup, this new Attex LPI Truck mounts a minicargo bed and optional track for swamp and snow flotation.

go deck, its \$3500 ATV can add an optional track over the six tires, and an outboard motor bracket.

■ For air-gun fans, Crosman is packaging its Copperhead BBs in three special new containers for easy carrying and loading afield.

■ There are detailed road maps for drivers, topographics for hikers and marine charts for sailors. Now, there are maps for fishermen and skin divers that outline underwater contours and show where the fish should be. So far, they cover 150 lakes and impoundments in 20 inland states, and are printed on waterproof, plastic-type paper. Tackle shops and marinas stock them, or they can be ordered postpaid for \$3.25 from Outdoor Products, 302 East 32nd St., Joplin, Mo. 64801.

Where it's at

■ Anglers ready to graduate to the special pleasures of fly fishing should contact Joan and Lee Wulff. Their Wulff Fishing School, Lew Beach, N.Y. 12753, on the Beaverkill River, provides a how-to chance for a week or weekend of lessons with this most famous of fishing couples. Beginners can start developing skills for trout and Atlantic salmon, and old-timers can correct years of bad habits. It isn't often you can get world champions as private tutors.

■ Sportsmen looking for action can

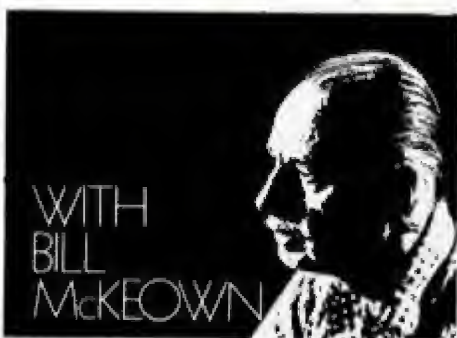
find it worldwide in the latest listings of *Outdoor Adventures*, available at travel agents and Braniff offices, or for \$1 from Braniff Outdoor Council, Box 47086, Dallas, Tex. 75274. North American activities are listed in *Adventure Travel* by Pat Dickerman, \$9.20 postpaid from Adventure Guides, 36 East 57th St., New York, N.Y. 10022. They are also the source for *Farm, Ranch and Country Vacations*, \$7.20. Bargain hunters can find them in the *How to Fly for Less* booklets, \$5, and *1001 Sources for Free Travel Information*, \$4.90, from Travel Information Bureau, Box 105, Kings Park, N.Y. 11754.

■ And to search out sources for those special items of outdoor gear



New Economate 3.5-hp motor from Chrysler is a 32-lb., single-cylinder, no-frills model that is slated to sell for about \$300.

you've heard about or seen somewhere, but can't find, write Early Winters, 110 Prefontaine Place S., Seattle, Wash. 98104, for their catalog. If you don't locate it there, they offer a special free "Seeker Service," that will help you find almost any kind of outdoor equipment. **PM**



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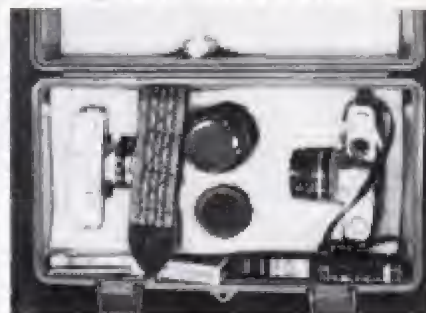
PHOTO HINTS

Battery checker



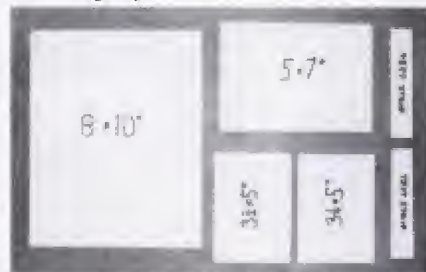
A piece of bent wire makes a simple battery tester. Loop one end around a flashlight bulb; a good battery will light the bulb brightly. Often, only one or two cells in a pack need replacement. So the tester prevents needless disposal.—*Bob Berger*

Fishing for a camera case



A tackle box converts into a camera case that offers low-cost protection from rain, salt water and other harmful elements. Foam padding wedged into the top and bottom cushions impacts, and can be custom-cut for different equipment.—*Donald L. Groh*

Cutting up in the darkroom



Use 8x10-inch paper economically by slicing an inch off a long edge to give two 5-inch test strips. Then cut the sheet to make 5x7-inch or smaller prints. The 3½x5-inch size is useful because it accommodates the full 35-mm frame.—*Robert Hertzberg*

NEXT MONTH IN PM

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CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



Not as a stranger

I recently bought a used 1977 Ford with 351M V8 engine and two-barrel carburetor. The automatic choke takes forever to release. Until it does, the engine bucks, snorts and stalls. My mechanic has rebuilt the choke system from the ground up, but it hasn't helped. He says it's one of the strangest problems he's encountered in 30 years. Can you help?—Tony Valenti, Boston.

There was a period of 30 or so days during production of Fords, Lincolns and Mercurys when model 2150 two-barrel carburetors weren't built properly. Many of them left the factory with inadequately drilled choke air passages in the main body. This restricts the flow of vacuum and causes the choke to remain closed for an excessively long time. You may have bought a car having one of these problem carburetors. To find out, let the engine idle and hold your finger over the choke cold-air opening. If there is little or no vacuum, you've got one of the bad carburetors.

While your problem is not unusual, it certainly is odd that it should crop up so long after the car was built. Ford tells us that the engines fitted with this carb ran so poorly that new carbs were installed before the car was actually delivered to the customer, or within a few days of the owner taking possession of the car.

In 1977 the carb replacement was a warranty job and, naturally, was done for free. In your case, Tony, we've given your name and address to Ford, and a service rep will be calling on you to solve your problem.

If anyone else has the same problem, Ford advises you to get in touch with the District Customer Service Office. To make it easier on Ford to track down the specific problem, refer to service bulletin No. 140 issued Aug. 8, 1977, article No. 1942.

Trouble on the Horizon

My 1978 Plymouth Horizon has been losing transmission fluid from the

transaxle and no mechanic—dealer or independent—has helped. Have you run across this before?—Allen Meade, Glendale, Calif.

Yes, several times on both Horizon and Omni. The leak can be caused by a defective transfer-shaft oil seal and/or a defective driveshaft oil seal.

Transmission fluid will leak from the differential vent if the transfer-shaft oil seal is damaged. Fluid is drawn from the transmission sump, past the seal into the differential, and out the vent. Assuming that this is what's happening, the oil seal (part No. 5222015) and transfer shaft retainer O-ring (part No. 6500169) must be replaced, but bear this in mind: If the seal was butchered by a rough sealing surface on the transfer shaft, the new seal will soon be damaged. If the transfer shaft is in poor shape, the shaft, too, will have to be replaced.

Transmission fluid may also be leaking from one, or both, driveshaft oil seals. To find out, remove the driveshaft and inspect the inner

sealing surface for nicks and burrs. If damage is found, replace that section of the driveshaft. In any case, install a new improved driveshaft oil seal (part No. 5205591), which is green. The old oil seal is blue.

Springing into action

My 1977 F-150 Ford pickup truck is equipped with a 351-M series engine. When I bought the vehicle in late 1976, the clutch pedal seemed to take very little effort to push to the floor. Upon releasing the pedal, there seemed to be a little slippage of the clutch. However, the dealer assured me this was normal, so I continued driving the vehicle.

Now, at 33,000 miles, the clutch has given out and a new one of the same type has been installed. But mechanics at the dealership have warned me that this clutch has inherent problems, and it will fail between 30,000 and 40,000 miles. Are they right?—Robert L. Worley Jr., Houston.

You should have replaced the original clutch-return spring long ago to keep the clutch from slipping on return. This could, of course, account for clutch failure at 30,000 to 40,000 miles.

If your truck is a 4×2, the new spring carries part No. D7TZ-7523-E. If your truck is a 4×4, the new spring has part No. D7TZ-7523-D. If the dealer tells you *Car Clinic* is full of beans, tell him to consult article 1764 of service bulletin No. 129.

Don't argue with success

When I bought my Chevrolet Citation last October, it hesitated on acceleration and stalled in the middle of left

(Please turn to page 44)

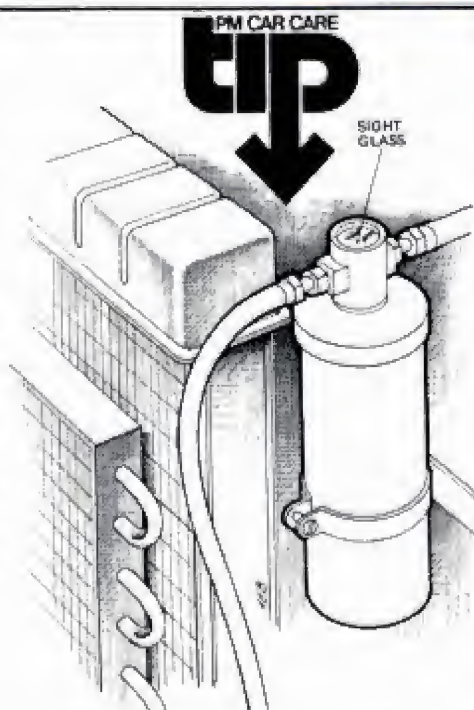
Quick, cool tip

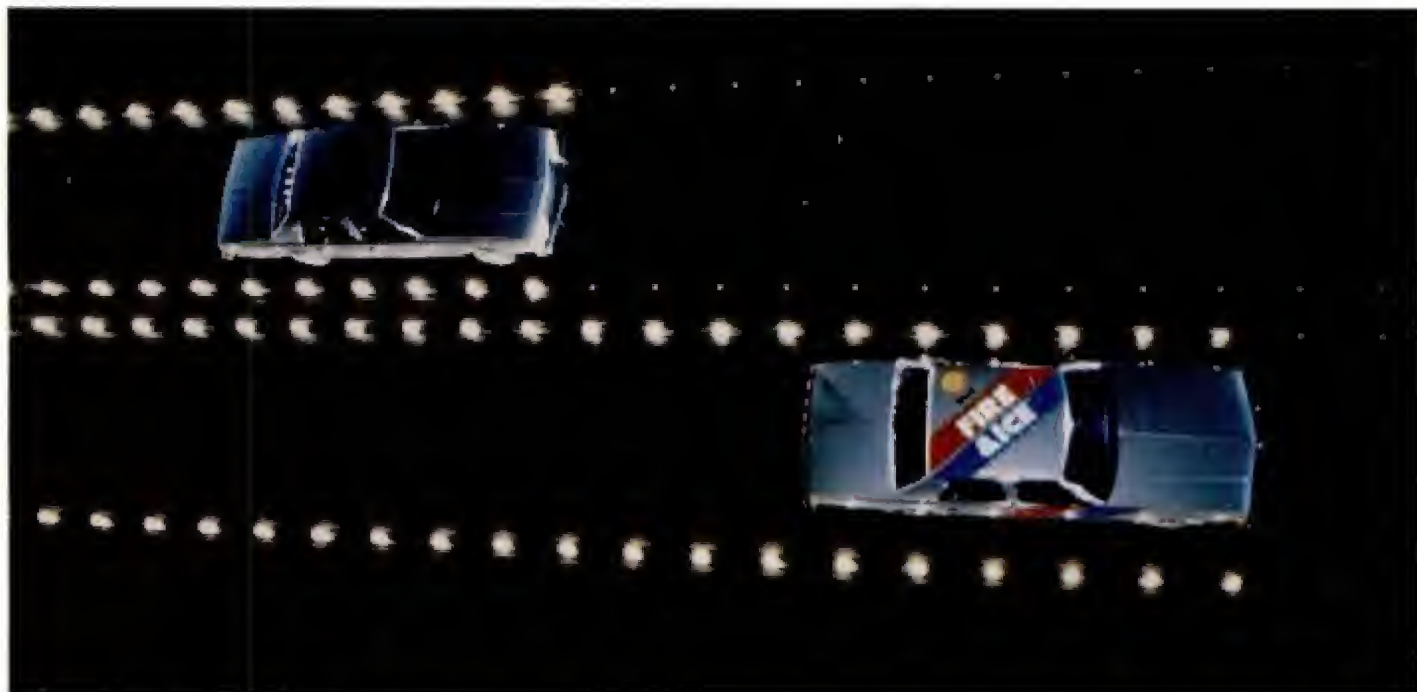
If you wonder whether your car's air conditioner is low on refrigerant, it's a good idea to check the system through the sight glass.

In most cars, the sight glass is located on top of the receiver-dryer unit. The glass may be covered by cardboard in order to protect it. If this is the case, you must first remove the cardboard.

If the sight glass isn't mounted on the receiver-dryer, look for it on the line between the condenser and expansion valve. The expansion valve is on the condenser side of the evaporator.

With the engine running, and after the air conditioner has been operating for several minutes, look into the sight glass. If bubbles are present, it's an indication that there is a low charge of refrigerant.





Improved Shell Fire & Ice[®] 10W-40 Motor Oil was compared to old formula Shell Fire & Ice for gasoline mileage. Here's what happened.

Shell Fire & Ice beats Shell Fire & Ice

Shell Fire & Ice first became famous as a protection motor oil. A television commercial seen since early 1979 dramatically showed that Shell Fire & Ice 10W-40 Motor Oil protected a car's engine.

1979



A car frozen in ice starts on the first try using Shell Fire & Ice Motor Oil.



The same car, 36 hours later, using the same Shell Fire & Ice Motor Oil tows a 30-ton crane through desert heat with no engine damage.

But what about gasoline mileage?

Since that television commercial was made, Shell Fire & Ice was

reformulated to improve gasoline mileage — and to do this without sacrificing engine protection.

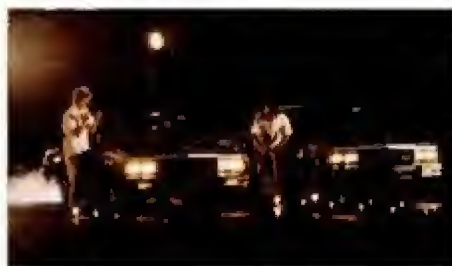
It's one thing to say a product is improved, another thing to prove it. Shell proved it. How?

Using several different cars under carefully controlled laboratory conditions, we compared the improved Shell Fire & Ice formula to old Shell Fire & Ice.

The results: The cars we tested averaged 17.3 mpg; but with improved Shell Fire & Ice, the cars averaged one-third of a mile farther on every gallon of gas.

A new TV commercial

With an improved product, it seemed fitting to make a new commercial to dramatize the improvement. So we did.



Two 1980 Chevrolet Caprices get last-minute checks before the television cameras roll.

After all, one-third of a mile is one-third of a mile. It's a distance



Ground-level tracer lights dramatize the extra distance test cars averaged using improved Shell Fire & Ice.

longer than five football fields. It could be the difference between making the next freeway exit or running out of gas. And we're talking per gallon not per tankful.

Try it in your car.

At Shell, we believe in making good products — then making them better. Try Shell Fire & Ice 10W-40 Motor Oil in your car. It's the motor oil that first became famous for protection — then went out and beat itself in mileage tests.



CAR CLINIC

(Continued from page 42)

turns. The dealer replaced a cracked carburetor float and the EGR valve, and increased idle speed. No effect. He then raised the carburetor float $\frac{1}{16}$ inch from specification. Success. The car runs beautifully. However, I now get 18 mpg, instead of the 22 mpg I used to get. What do you make of all this?—G.F. Merz, Aiken, S.C.

An estimated 200,000 X-body models (Citation, Omega, Phoenix and Skylark) are now the subject of a National Highway Traffic Safety Administration investigation, because they have been stalling on acceleration and/or on turns. NHTSA has said that, so far, 171 complaints have been received and there has been one accident, resulting in injury.

Until the investigation has been completed and modification made (if there is to be one), you'd best live with the drop in gas mileage. It's better than having your car stall in traffic and, possibly, serving as a Ping-Pong ball for other cars.

Two for the price of one

My 1975 Dodge Dart (225-cu.-in. engine) loses about a gallon of coolant a

year. There are no obvious leaks in the cooling system. Concurrently, I find a cream-colored deposit that resembles a gel hand cleaner under the oil filler cap.

Do you think this is an indication that coolant is leaking into the oil? The drained oil looks normal.—B.P. Solomon, West Lafayette, Ind.

I doubt if the two are related. That deposit under the oil filler cap is a sign of excessive condensation buildup, or that you're using an oil additive. Some additives leave sludge.

Condensation often results from short trip driving in cool weather, because the engine doesn't get hot enough to burn off moisture. The problem can also result from having a thermostat fail in the open position. Again, this keeps engine heat below par.

As for coolant loss, perhaps coolant is being lost into the combustion chamber through a pinhole in the head gasket or, perish the thought, through a crack in the cylinder head.

You can have a radiator shop do a block check to find out. They'll warm up the engine and place the block tester on the car. If the blue liquid of the tester changes color, it indicates

Calling Dr. Mechanic

Seldom considered for inclusion in a tool inventory, a mechanic's stethoscope is invaluable when you want to find an elusive noise located in the engine compartment. With the engine running, hold the probe on components that have moving parts, such as the alternator, and on the engine block itself to isolate noise to a particular spot. The tool sells for about \$10.

PM CAR CARE
TIP
↓



LEADERS HAVE TASTE

Even the look of the A&C Grenadier rewards the choosy smoker.

It's long and lean. Touch a match to it, and here comes rich, exciting aroma, full and satisfying taste. At its heart, a richly rewarding blend of five fine imported and domestic tobaccos. All of this sealed in our Fresh Loc package. When you've got the taste for leadership, light up an A&C Grenadier. In light or dark natural wrapper.



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The Dry Look leaves hair feeling as soft and natural as it looks.

The Dry Look gives you more than a great look. It leaves your hair feeling soft and natural, too — not too stiff. The Dry Look in pump spray or aerosol — with a formula that's right for your hair. Get The Dry Look...and don't be a stiff!

© The Gillette Company, 1980



Available in pump or aerosol.

a leak through which coolant is probably being lost.

On the horns of a dilemma

I slowly drove my 1974 Saab 99 through a foot or so of water. It was an expensive experience. In the middle of the puddle, my car died. Resurrection expenses came to \$1500. It seems the air intake of this car has a plastic horn that points down. Water was sucked right into the engine, shattering a piston, breaking a rod, bending the crankshaft and throwing a rod into the transmission.

Let this serve as a warning to Saab owners. If the horn attached to the air intake faces down, remove it or stay out of puddles.—Terry Gammon, Soda Springs, Ida.

Sorry about your trouble, Terry, but maybe you can have some satisfaction in knowing that your experience may help other Saab owners avoid similar problems. Thanks for sharing it with us.

Cherokee hunting party

Why, for heaven's sake, does my 1978 Jeep Cherokee automatic transmission drop to second gear from third when the vehicle is cruising from 30 to 45 mph? Is the same problem causing the transmission to hunt between

second and third when the vehicle is going uphill?—Ken Klein, Walla Walla, Wash.

If you've checked all the obvious causes of transmission hunting, such as lean carburetor fuel mixture, incorrect ignition timing and a disconnected vacuum line, have a dealer install a delay valve (part No. 5355276) between the EGR valve and EGR coolant temperature override switch. As matters now stand, when the EGR valve opens, a sudden drop in engine vacuum causes the transmission to downshift. The delay valve will prevent vacuum from dropping to the point of affecting the transmission.

The other problem you mention is also caused by a drop in vacuum, which occurs while you're going uphill under fixed part-throttle, light-acceleration conditions.

A new valve spring (part No. 8129681) added to the 3-2 valve body of the transmission will prevent this.

GOT A PROBLEM WITH YOUR CAR?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

Safety and service tips

■ If you've been bugged by fluid leaks from the transmission of a Cadillac Eldorado, there are two service bulletins your Caddy dealer should apply: T 79-31 and T 80-5.

■ An extensive study by the National Transportation Safety Board has shown that you're more than four times as likely to have a fatal accident on wet pavement than on dry. A state-by-state comparison shows Utah, Texas, Illinois, Arizona and Missouri with the highest incidences—Alaska, New Hampshire, Nevada, District of Columbia and Pennsylvania with the lowest. The Board thinks that differences in accident rates have to do with material used in the pavement, but they aren't sure. Whatever the cause, the message is clear: Drop your speed when it's wet.

■ Ford Parts and Service Div. has a host of good car and truck technical publications for sale that cover 1972-80 Ford, Lincoln and Mercury models, including shop manuals, wiring diagrams and electric troubleshooting manuals. For a complete list, write for the Service Publications Order Form. Address your request to Helm Inc., Publication Div., Box 07150, Detroit, Mich. 48207.

■ I just found out what to do if the ignition switch binds in a 1979 Chrysler New Yorker, Newport, St. Regis or LeBaron; Dodge Aspen or Diplomat; or Plymouth Volare. If your dealer doesn't know, have him consult service bulletin 08-20A-79. He must see the revised one. **PM**

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One of these men drives himself to work, drives himself home and drives up his cost of living.

He doesn't see it that way. He's been driving himself to the office every day for several years now. He actually enjoys the ride.

Problem is, with today's energy crisis, the man on the right is wasting both fuel and money. Gas prices alone make the trip expensive. And his auto insurance premium is higher than it has to be.

The man on the left has decided to conserve and save. When the gasoline shortage began, he and some neighbors started carpooling to work. So together they consume less gas. That cuts expenses right there. What's more, because each of them drives fewer miles, they save money on their auto insurance as well.

As a major group of property and casualty insurance companies, we're doing our best to help you keep your insurance rates affordable. That's why most auto insurers are offering discounts to those individuals who reduce the total number of miles or times they drive to work.

For example, people who normally drive 30 miles to and from work every day can save up to 22% on car insurance premiums just by carpooling. All they have to do is drive to work two days a week instead of five.

People who switch to public transportation to get to work save even more on their premiums—up to 31% in some states. Their car becomes classified "for pleasure use only," a less expensive category.

Here's what we're doing to control costs:

- Offering premium discounts to those who reduce the total number of miles they drive each week to work. Discounts will vary by company, by state and by the type of coverage you have.
- Cracking down on insurance fraud practices through the Insurance Crime Prevention Institute and the National Automobile Theft Bureau.
- Working through the Insurance Institute for Highway Safety to make cars and roads safer.
- Investigating injury and repair claims more thoroughly.

Here's what you can do:

- Cut down on your driving by carpooling or by using public transportation.
- Use your auto seat belt and shoulder harness.
- Talk to your insurance agent or company about ways to lower the cost of your auto insurance coverage.
- Lock your car. Don't invite trouble.

Affordable insurance is our business...and yours.

This message is presented by the **American Insurance Association**, 85 John Street, New York, New York 10038.

APPLIANCE CLINK

QUESTIONS ANSWERED

Plugged humidifier nozzle

I have an air-plenum-mounted humidifier. Every season the atomizing nozzle becomes clogged and I have to replace it, even though it is connected to the water softener. Is there any way to clean the nozzle or keep it clean while it is working?—Steve Glickman, Lansdale, Pa.

Assuming the water softener is working and the line is clear to the humidifier, you can clean the nozzle with household vinegar. Once it's clean, purchase some water-treatment tablets for humidifiers and drop one or two into the unit, according to instructions. These tablets will not only condition the water, but will help prevent sludge buildup on the moving and stationary parts.

Flaky oven interior

I own a 6-year-old Westinghouse Electric Continuous Clean Range in which the oven liner is flaking and beginning to rust. The service company quoted a price of about \$90 for a new interior. Is there a paint that I can use to touch up the interior? Also, what is the life expectancy of an electric range?—Mrs. J. D'Elia, Newton, N.J.

Continuous-clean oven liners normally are expected to last the lifetime of the oven, which, according to Westinghouse tests, averages 11 to 12 years. However, many variables can shorten the normal life. Some variables are times and methods of cooking, types of food spills, and oven-cleaning chemicals used on the porous interior.

Westinghouse doesn't recommend any paint for interior oven use. The proper procedure is to replace the defective liner with a new one. The estimated cost for parts and labor is about \$170.

In and out water

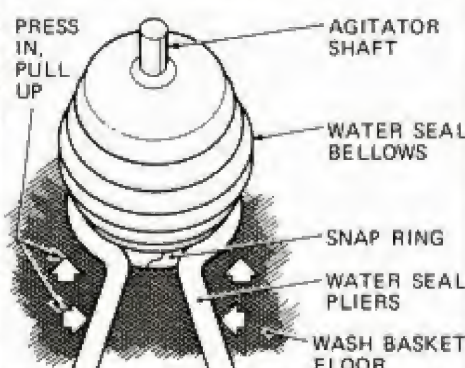
I have a Frigidaire Jet-Action Washer, Model No. WCDARN, Serial No. 75VD2638. When I start the machine, the water comes in, then starts to flow out my storage hose into the basin sink. What is wrong?—Redo Celli, Carnegie, Pa.

It sounds as if the water-seal bellows under the agitator is either torn or punctured. This results in wash water flowing from the wash basket, through the seal, into the outer tub and through the storage hose. A new bellows, part No.

5433244, costs about \$6. You will need two things to position it: a Rob-inair water-bellows clamp ring tool (part No. 12071, which costs about \$6) and lots of patience.

To get at the agitator, you have to take off the soap dispenser on top of it. You can do this by removing either the Phillips-head screw or the $\frac{7}{16}$ mounting nut inside it. Next, remove the large, white metal nut. Now jiggle and pull the agitator until it slips off the shaft. This may take time.

After you remove the agitator,



Water-bellows pliers opens the snap ring.

you will see the water-seal bellows. Clamp the water-seal pliers around the snap ring at the base of the bellows, press in, and lift. Soak the new bellows in hot water to make it more pliable and easier to attach. Press the new bellows over the tub lip and carefully reinstall the snap ring with the tool.

Check to make sure that the snap ring is tight and locked in place. Reinstall the agitator and soap dispenser and check for leaks.

Frozen food disposer

I own a Frigidaire Food Disposer, Model No. FDF-6. About every two weeks, if I don't use it often, the motor freezes and trips the overload protector. Then I must work the motor loose by using a long extension and socket on the center bolt of the rotating element and reset the breaker. Could you tell me what's wrong and how I can repair it?—Grosvenor Swift, Port St. Lucie, Fla.

It sounds like your motor either has a bad bearing or a dead spot in the start winding. In either case, the motor must be removed and repaired by a factory-authorized service technician. One such place is: Good Housekeeping Shop, 305 Orange Ave., Fort Pierce, Fla. 33452. If

you contact them, they can give you an idea of the cost to repair your food disposer.

Cool and muggy

My problem is poor dehumidification in the airconditioning mode of my Lennox heat pump (Model No. HP8-311-1FFP). My house is 5 years old, insulated with vapor barriers, and equipped with double-insulated windows. There is a dehumidifier in the basement and also an electric clothes dryer that is vented. The dryer is used little in summer.

Last summer, when the house was cooled to 75°F., the humidity felt much higher than airconditioned houses I used to live in. I used an inexpensive hygrometer to measure the humidity. It was 70 percent. Water drainage from the cooling coil is not obstructed. Do you have any ideas that can be applied to my heat pump in preparation for this summer?—Harold E. Stelling, Middletown, Md.

No, because we doubt if the heat pump is to blame. At first, we thought that perhaps your unit was oversize for the home. If the heat pump was too large, it would cool the home quickly and shut off, leaving humidity at an elevated level. But we talked with people at Lennox in Dallas who said that your model is a 2½-ton unit that will serve a moderate-size home.

Since heat pump and home size probably match, the cooling-humidity control function is automatic. The humidity will drop to a comfortable level coincidental with the temperature, if there is not an unusual humidity-producing condition in the home.

We suggest that one of the first things you do is call a Lennox dealer and have him measure humidity with his instruments. If he confirms humidity is too high, find the source of the problem and try bringing it under control.

One reason for the high humidity may be that your house is well insulated. Vapor is thus retained in the house instead of escaping. If this is true, installing a dehumidifier in the living quarters will help. **FM**

If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

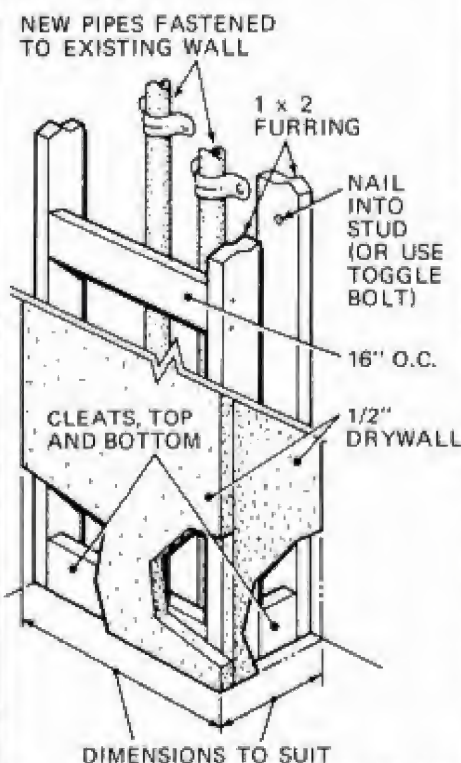
HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Sediment in pipes

The plumbing in my 80-year-old house was redone about 30 years ago. My problem is the buildup of sediment in the water pipes. I've taken out and cleaned sections that are accessible, but other areas are hidden in the walls. Can I isolate my system somehow and flush it clean with a mild acid solution? I've seen this done in industrial plants.—Roger A. Felthous, Claremore, Okla.

Once sediment builds up in water piping, a slight pipe deterioration starts. In time, this creates a rough surface, which causes further buildup. Eventually, the pipe fails. Flushing can't remove the rough spots in the pipe.



DIMENSIONS TO SUIT
New surface-mounted pipes can be concealed with an enclosure (called a pipe chase) made of 1x2 furring and drywall.

A check with mechanical engineers and plumbing contractors confirmed my beliefs. Never flush an acid, no matter how mild, through your water system. Your piping must be replaced. If you don't want the mess of replacing pipes behind walls, consider abandoning the existing system and fastening new pipe to the wall surfaces. You can conceal the newer piping with pipe chases constructed of 1x2 furring strips and drywall, as shown in the drawing above.

Check-valve checkmate

In the March '80 Homeowner's Clinic (page 34), we showed a diagram of a plumbing loop for recirculating domestic hot water. Morris Peelle of Dundee, N.Y., was the first of many observant, knowledgeable plumbers who noticed a flaw in our sketch.

In order to prevent cold water from being drawn from the bottom of the tank (return line) when the faucet is opened, a check valve must be installed in the return line.

It was unanimous that a swing-gate check valve would be the best type. Retired Master Plumber Clifford Saywell of Jamesport, N.Y., suggested the valve be installed about 18 in. past the new tee on the return side of the faucet. Thanks, Morris, and all the others who wrote to us.

Curious woman

The rubber-backed, indoor-outdoor carpet in my kitchen is glued to the floor. It's too expensive to remove the carpet and sand the floor prior to putting down cushioned sheet vinyl. Can I glue the vinyl over the carpet? The edges would be covered by moldings and the carpet would add insulation.—Mrs. B. Jordain, Jerome, Idaho

I'm afraid you'll have to live with the carpet, or remove it to install cushioned sheet vinyl. The key word is cushioned, meaning that the material is already padded.

Additional padding, such as carpet, won't work. The vinyl will show all indentations (tables and chair legs). Eventually it will be pierced. A spokesman for the Armstrong Cork Co., Lancaster, Pa., verified this. It may pay to hire a neighborhood teen-ager to help strip the old adhesive off the floor. Although the carpet is warmer to the touch, the insulation value is negligible.

Reroofing products

Our 34x40-ft. roof has a 1½-in. pitch per foot and is covered with 90-lb., gravel-coated felt roofing. We have been troubled by a few leaks lately and were wondering what type roof

(other than hot mop) we could use to reroof. We realize that we don't have enough pitch for shingles.—E. Davis, Brookings, Ore.

The Oct. '78 Homeowner's Clinic ("Leaky Tar Roof," page 40) mentioned a product by Water Guidance Systems that allows you to apply a new, strong material "loosely" over the existing roof. The material is fastened to the building at the edges only. It comes in 54-in.-wide rolls with special materials to seal the seams. The company's home address is: Box 312, Canton, Mass. 02021.

A similar product is called Plyroof. It's made by International Roofing Systems Inc., 352 C St., Boston, Mass. 02127. Write for the name of the nearest supplier. Both products can be installed over existing roofs (after the gravel is removed) so that your home won't be exposed to inclement weather during reroofing.

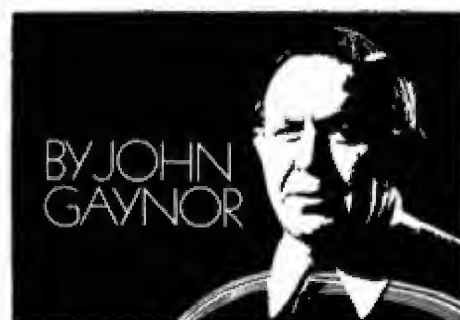
Waste not

I have a great amount of used lumber, mostly nominal 2-in. and larger stock. It's select grade with few nail holes and is very dry. It splits easily when I nail it close to an edge. Someone suggested I soak the wood prior to nailing. Do you have any suggestions?—A.J. White, Marina Del Rey, Calif.

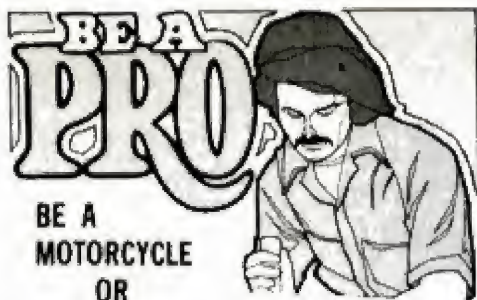
The first method I would try is to hold the nail point end up with its head flat on a solid base. Then blunt the point of the nail by tapping it with a hammer. This allows the nail to cut the wood fibers, similar to the action of a chisel, rather than push between the fibers, causing the wood to split open. This method usually works.

Predrilling the wood may be the only other method of nailing without splitting. Don't soak the wood under any circumstances. Dryness is always desired. This cuts down on the amount of warping and splitting associated with wet wood. **PM**

Do you have a home maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send order(s) to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.



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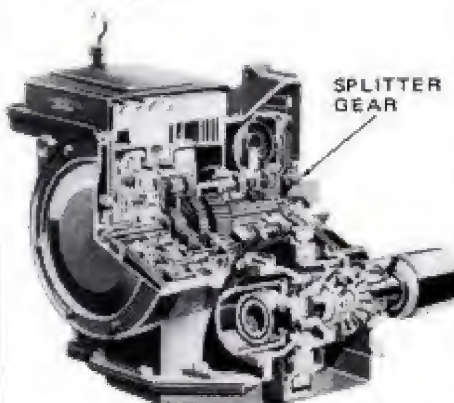
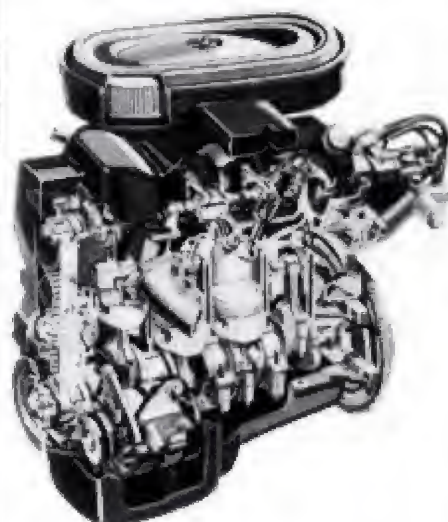
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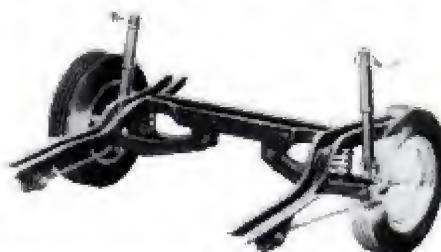
DETROIT LISTENING POST

'81 Ford Escort/Lynx

More and more is being revealed about Ford's upcoming front-drive Escort (and Mercury's sister ship, Lynx), which will replace the Pinto and Bobcat this fall. Probably the



Ford's new engine (top) is an overhead-cam mill with hemispherical combustion chambers. Automatic transmission (above) uses a splitter gear to vary fluid slip.



Escort/Lynx rear suspension is independent, has transverse arms, coil springs.

most significant engineering feature is a super fuel-efficient, three-speed automatic transmission available with the optional 1.6-liter engine. Labeled ATX (automatic transaxle), it has a unique "splitter gear" that divides the torque be-

tween "hydrokinetic" and mechanical transmission systems.

An ordinary automatic transmits all power through its fluid-filled torque converter. A "lockup" automatic (now offered by all of Detroit's makers) shifts to 100 percent mechanical transmission in high gear through a clutch arrangement.

The Escort/Lynx ATX, on the other hand, is 100-percent hydrokinetic in first gear, but 62-percent mechanical in second and 93-percent "locked up" in high, eliminating almost all fuel-wasting slippage. The bottom line, Ford says, is four to five mpg better fuel economy than competitive automatic-equipped cars. Yet, with its limited slip, it provides the smooth action drivers expect from an automatic.

Additionally, the new ATX is lubed for life and requires no fluid change or band adjustment. Ease-of-service features also abound, including a valve body that's accessible from the top, rather than from under the car, without draining the fluid.

We described the Escort/Lynx engines in April (see *Imports & Motorsports*, page 11), but more information has become available. For one thing, a Ford research team began its work way back in 1970. They bought 25 competitive Fours from both European and Japanese makers for evaluation, and carried out a comprehensive computer "mapping" program to determine what combinations of air/fuel ratio, spark timing and exhaust-gas recirculation (EGR) yielded the best fuel economy, emissions level and power. The mapping procedure indicated that a hemi-head design would give better horsepower, better torque and better economy than either a "wedge" head or a three-valve "pre-chamber" (stratified-charge) sys-

BY
GARY
WITZENBURG

tem similar to the Honda's CVCC.

The final configuration uses a single overhead cam with the valves angled slightly to either side of a central sparkplug. Called "CVH" for compound valve hemi, this arrangement allows larger valves for maximum flow, yet still provides clearance for the rockers. Under the handsome Escort/Lynx bodies (two-door and wagon this fall, sport coupe next spring, four-door for '82) sits a state-of-the-art suspension that should equal or better anything in its class.

MacPherson struts carry the load in front, with the left front "cambered" (sloped outward top-to-bottom) slightly more than the right to minimize front-drive torque steer. The fully independent rear suspension is also strut-type, but the coil springs are mounted over lateral swing arms. As in GM's X-cars, the wheel bearings are lubed for life.

This seemingly excellent platform will be used in several other new models in years to come. The '82 Fairmont/Zephyr replacements (code-named "Topaz") will use a stretched version, while a two-seat urban car ("Apex") scheduled for '85 will sit on a shortened Escort/Lynx chassis.

GM news

■ Cadillac won't confirm it, but reliable sources say that GM's luxury car division will adopt Eaton Corp.'s valve selector system (see *Driving a Car with 4, 5, 6, 7 or 8 Cylinders*, page 68, Nov. '77). It'll be used on the 6.0-liter V8 engine this fall. This system shuts off fuel and disables the intake valves to two of the eight cylinders at medium load, and to four cylinders at light load conditions. This achieves significant fuel savings.

■ GM's "S-car" front-drive minicompact, set to debut in Europe in 1983, will replace the Chevette here in '85. It will have a wheelbase of about 92 inches, weigh about 1800 pounds and use European-built drive trains and other components.

\$4.32 in Bulgaria?

You think we've got it bad? At last count, Bulgarians were paying \$4.32 a gallon for gasoline, Belgians \$3.11, Italians \$3.02, Israelis \$2.60, the British \$2.34 and the Japanese \$2.20. On the other hand, gasoline costs only 65 cents in oil-rich Mexico and 29 cents in Saudi Arabia. **PM**



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WE GIVE YOU THE EDGE.

Build the Basement Water Alarm

Don't worry about losing your valuables to flooding. This alarm will give you time to "clear the decks."

by Jeff Sandler

If your basement has ever flooded, you know the sinking feeling you get going through soggy papers, dripping clothes and ruined furniture. But you'll get an early warning if you build the *Popular Mechanics* Basement Water Alarm. Just a drop of water on any of its sensors triggers a pulsing alarm that can be heard throughout the house. And it won't stop until you shut it off, even if the water dries up. The alarm is battery powered, so it can be located just about anywhere in your house. More important, it provides protection even when the a.c. power is out.

Sensing trouble

Typical spots where trouble can start are your cellar, your washing machine, tubs, plumbing and heating system. Other sources of water are rainstorms, or high water tables that leak through cracks in the foundation. Upstairs, you are more apt to have problems with a dishwasher or other water-consuming appliance. In the attic, you'll want to check on roof leaks.

A flood is like a fire in that you need early warning if you're to cut your losses. So whether your flood is from "ordinary" sources as above, or "exotic," such as your fish in the aquarium getting into a fight and splashing water on the rug, the approach is the same. Decide first the locations that need protection. Then place the sensor face down, connect to the main alarm case with cable, and you're in business.

How it works

The operation is based on the fact that even totally pure water is a slight conductor of electricity. Impure or dirty water, such as you would have in a flood, is even a better conductor. Once water bridges the insulating gap on the sensor pattern, it conducts and sets off the alarm.

It takes about a second for the wet sensor (made following pictured de-

sign) to discharge the 10- μ F capacitor. The falling voltage induces the gates to reverse their output polarity (output of gate A was +9 volts, gate B was 0 volts). They remain in this reversed state until you reset them manually by shutting off the alarm. (Electronic circuits that reverse their states in response to a triggering signal are called flip flops, and are a basic building block of all computers and calculators.)

But for as long as the first two gates are reversed, the remaining two gates, which are wired as a square-wave oscillator, are energized. The square wave, alternating between 0 and 9 v., is applied to the transistor, which acts as a switch and pulses the buzzer on and off.

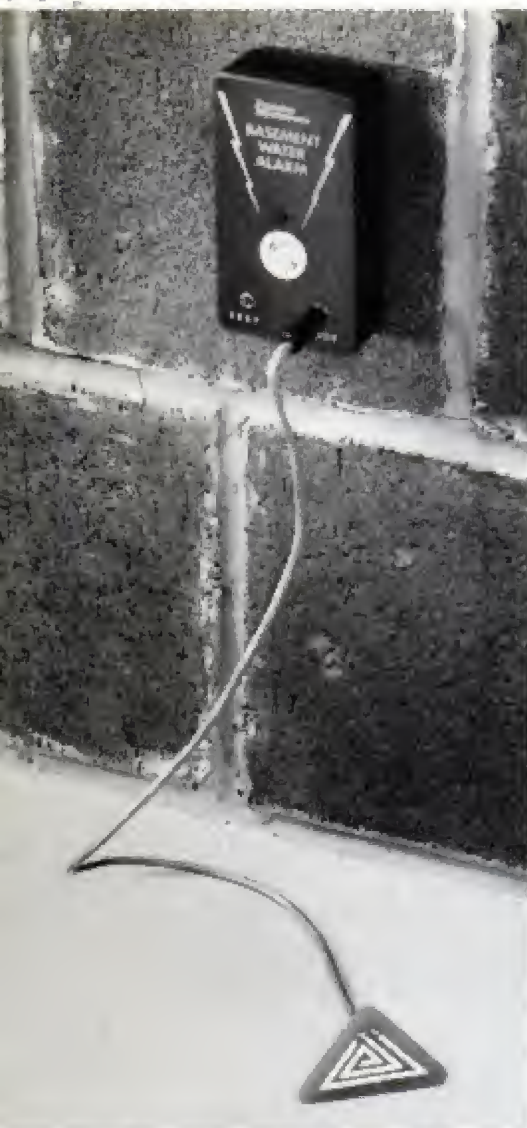
The trimmer potentiometer varies the duty cycle of the square wave, which simply means it varies the ratio of time that it's at 9 v. compared to the time that it's at 0 v. This enables you to have the buzzer sounding continuously, or you may adjust it down to a one-second beep every two minutes.

Long-lasting protection

Being able to have such a long time between beeps may not seem useful, but it does enable an ordinary 9-v. transistor radio battery to power the beeping alarm for several months. This may be important if you have to monitor some place that isn't visited too frequently. If the unit isn't beeping in standby mode, the battery lasts its shelf life.

Another contributing factor to the long battery life is the buzzer. It's a modern electronic cousin to the buzzer that you, your father, and probably your grandfather knew. Till now, buzzers have had electrical contacts making and breaking the current to the coil. The new way replaces the arcing contacts with a transistor. Since transistors are very efficient, the current draw is greatly reduced. Also, you get long

(Please turn to page 58)



PM's Basement Water Alarm will alert you with a buzzer in case of flood. We show it with one sensor, but you can design it with as many as you need. The alarm can be continuous or pulse intermittently.



Construction of the alarm is straightforward. If you've never built from scratch, give it a try—or a kit is available.

Until now, it wasn't just the birds that came back each spring.

Ever notice how the concrete cracks you repair one spring come back the next?

That's because most concrete repair products can't handle the expansion and contraction brought on by seasonal temperature changes. (Not to mention the constant exposure to day-to-day weather changes.)

But new DOW CORNING® Silicone Concrete Crack Sealant is different. It's 100 percent silicone rubber. So it forms a flexible, waterproof seal that won't crack, crumble or shrink as the seasons do their annual thing.

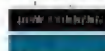
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You won't get a patched look either. DOW CORNING Silicone Concrete Crack Sealant blends well with your sidewalk, patio, driveway, foundation and other masonry surfaces.

Ask for DOW CORNING Silicone Concrete Crack Sealant wherever home or auto repair products are sold. And soon.

Early birds get a \$1.00 refund offer from Dow Corning right on the cartridge.

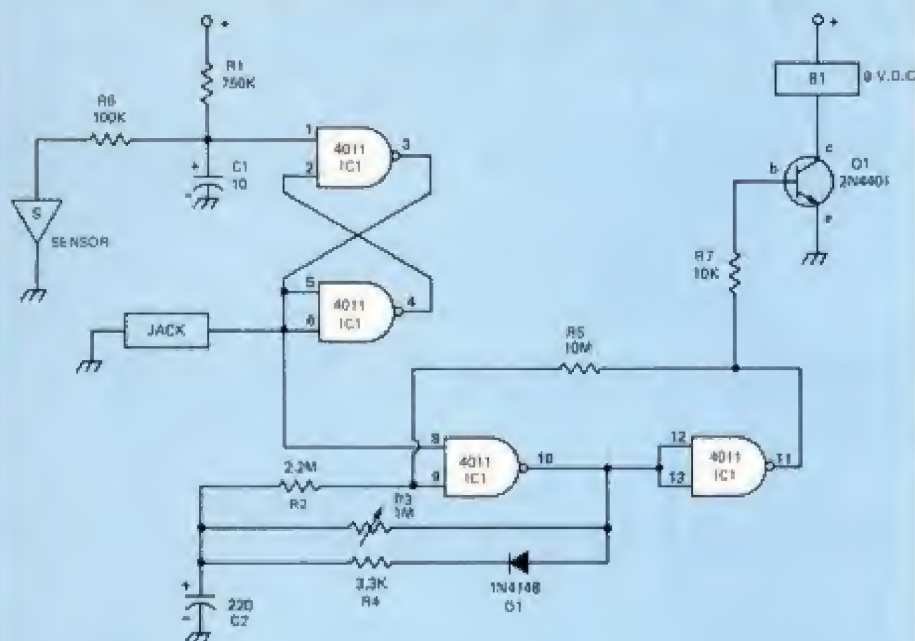
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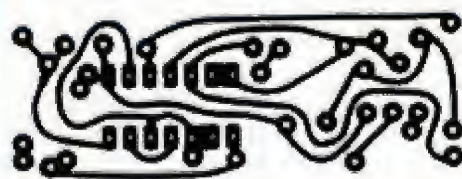
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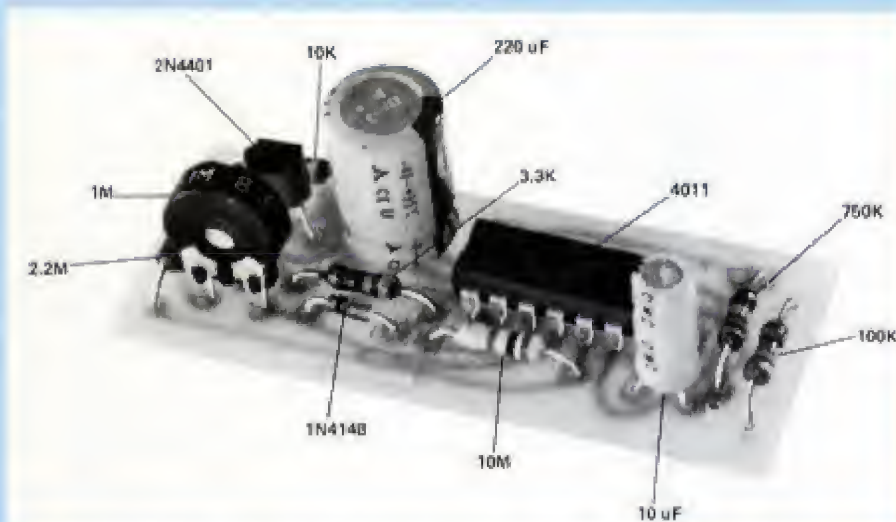
CONSTRUCTION OF BASEMENT WATER ALARM



Not shown in the schematic above are pins 7 and 14 of the 4011 chip. Pin 7 goes to the ground, pin 14 to positive voltage. Note the orientation of the 1N4148 diode.



Use these templates to make your own PC (printed-circuit) boards. To the left is a pattern for the sensor, while the main board is to the right. It's shown foil-side up.



Parts placement isn't crucial. Here's how everything goes together on a PC board like that above. You can also design your own less-compact wiring arrangement.

BASEMENT WATER ALARM

(Continued from page 56)

life and good volume level with a pleasant "mellow" sound.

Other uses

As anyone who has lived through spring in the snow belt will tell you, ice and snow is simply a flood waiting to happen. But an interesting property of ice leads to further applications for the alarm.

You could have a sensor sitting in a cup of water and naturally it would be conducting. But let the water freeze, and all the conductivity will disappear! It's as if the sensor isn't even wet.

Take a little chip of ice and rest it on the surface of the sensor; then put it in the freezer. If the temperature goes above 32° F., the ice will melt and set off the alarm. You could monitor the outside temperature by the same method.

Going further, by adding varying amounts of auto antifreeze or alcohol to water, you could make chips of ice that melt at any temperature that you want. You could monitor your deep freezer to make sure that the temperature didn't go above 0° F. as an application.

If you have a son or daughter who has a bedwetting problem—more common than people realize—there's a good chance that the basement alarm may be able to help. Simply place the sensor under the sheets.

The jack (closed-circuit type) serves two functions. The plug with the cable from the sensor goes into it. But in addition, once the alarm sounds, if you remove the plug, the jack shorts, which resets the circuit and shuts off the alarm. If you're only using one sensor, this is the jack to use.

The second jack (open-circuit type) is there more for convenience if you need only two sensors, since each would then have its own jack to plug into. By wiring sensors in parallel, you can have as many sensors as you want.

PM

PARTS LIST—WATER ALARM

- B1—9-v.d.c. battery
- C1—10-uF electrolytic capacitor, 10 v.d.c.
- C2—220-uF electrolytic capacitor, 25 v.d.c.
- D1—1N4148 diode
- IC1—SCL4011 or equivalent
- Q1—2N4401 NPN transistor or equivalent
- R1—750,000-ohm (750K) resistor, 1/4-watt
- R2—2.2M (megohm) resistor, 1/4-watt
- R3—1M (megohm) trimmer potentiometer
- R4—3,300-ohm (3.3K) resistor, 1/4-watt
- R5—10M (megohm) resistor, 1/4-watt
- R6—100,000-ohm (100K) resistor, 1/4-watt
- R7—10,000-ohm (10K) resistor, 1/4-watt
- S—Printed-circuit-board sensor
- Misc: Jacks for cables (see text); case, cable, wire, PC board materials.



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not satisfied, I'll return it for an immediate refund, no ques-
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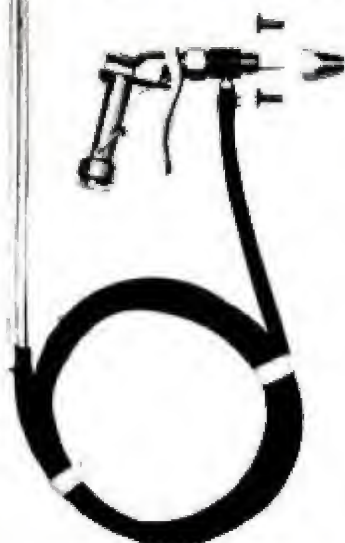
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FIRSTHAND REPORT

Driving the Volkswagen Jetta



Quick response and agile handling make the Jetta a nimble back-road performer.

This Rabbit with a trunk proves economy isn't cheap.

by Tony Assenza AUTO EDITOR

Just like in the animal world, Volkswagen's Rabbits seem to be multiplying at a prodigious rate. In the space of one year, VW has introduced no less than three Rabbit variants. First came the Rabbit convertible, which filled the ragtop void left when the Beetle convertible departed the scene. Then came the Rabbit-based pickup, VW's entry into the mini-pickup market currently dominated by the Japanese. The latest VW offering is the Jetta, a Rabbit with a trunk.

Like its predecessors, the Jetta is all Rabbit underneath the sheet metal, and it seems to be VW's attempt at building a mini-BMW. However, just like a BMW, there's

nothing mini about the Jetta's sticker price. But more on that later.

The Jetta is available in either two- or four-door models and can be had with the standard-equipment five-speed manual transmission or three-speed automatic transmission. The 0 to 50 mph acceleration for the five-speed is 8.5 seconds, while the automatic will get you there in 9.8 seconds. The automatic option also imposes a mileage penalty. The five-speed is rated at 25/40 mpg and the automatic at 22/31 mpg. California models are rated at 26/40 mpg for the five-speed and 22/32 mpg for the automatic.

The only engine available on the Jetta is the 1588-cc (97-cu.-in.) fuel-injected Four, which produces 76 hp at 5500 rpm. The 49-state version of the engine has conventional breaker-point ignition, while the California model uses an electronic, breakerless ignition system. Both engines, however, share the same CIS fuel-injection system. As yet, there

(Please turn to page 62)



The four-door model provides easy exit and entry for rear-seat passengers. From behind, the Jetta looks like a little BMW and can boast of excellent rear visibility.





"I studied hands from all over the world, so the OM-1 would fit comfortably in your hands."

The Olympus OM-1 was not an instant camera. It took 5 years for Maitani, the celebrated Olympus designer, to create the world's first compact 35mm SLR.

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The OM-1 is a third smaller and lighter than its bulky predecessors.

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Maitani



Yet compact as it is, the OM-1 is still one rugged camera.

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A lot of cassette makers have probably considered asking Stevie's opinion about their performance. But he's such a perfectionist, they may have been scared off.

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For Stevie, "It's a little music machine that delivers the best sound, for its size, I've ever heard." There's good reason. Its 250 components are checked thousands of times; 1,117 checkpoints for the shell alone. And SA is guaranteed a lifetime.* Enough to please any perfectionist.

* In the unlikely event that any TDK cassette ever fails to perform due to a defect in materials or workmanship simply return it to your local dealer or to TDK for a free replacement.

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U.S. Olympic team



Look for TDK in bright
new packages

DRIVING THE VOLKSWAGEN JETTA

(Continued from page 80)

is no diesel option available.

Like the engine and gearbox, the rest of the Jetta is 100-percent Rabbit. There is nothing new lurking anywhere. Obviously, VW hasn't gone out of its way to offer anything unique in this car—nothing beyond what is already available in the Rabbit. This is a pity, because such a good-looking, and expensive, little sedan deserved at least a major revision in the interior.

While the interior can't be faulted in principle, it certainly does leave room for improvement in its execution. One glaring example is the imitation wood applique on the dash. It doesn't seem to complement the classy-looking exterior. And the contrast is even more noticeable with the silver-metallic paint job. The exterior simply promises more than the interior can deliver.

In all fairness—and questions of taste aside—the whole package, both inside and out, is well put together. It's evident that quality control is still a high priority at VW. And that feeling of tight, solid construction becomes more apparent with each passing mile. There are no mysterious squeaks or rattles, no wires drooping from under the dash and no overspray drips on painted surfaces. We wish the same could be said of many domestic cars we've seen recently.

Since its introduction, the Rabbit has been hailed as a masterpiece of efficient packaging and styling. It's an enduring design that won't begin to look dated for a long time, as befits the natural successor of the Beetle, which hung on for decades. Then why did VW fool around with such a successful design by sticking a boot on it? The answer has to do with diversification and image.

Volkswagen, and several other car companies, have perceived that a



Jetta's trunk is huge (22.3 cu. ft.). It can carry a whole family's luggage very easily.

certain segment of the car-buying public simply doesn't like the hatchback or fastback look.

The other question of image is more subtle. Image has more to do with perceived, rather than real value. Park a Rabbit and a Jetta side by side and the point becomes clear. The Rabbit says utility, function and economy. The Jetta, on the other hand, evokes a more refined—even elegant—image. In the long run, this perceived image of class translates into money. The carmaker can charge more for the classier-looking car and feel confident that a potential buyer won't flinch at the price, simply because the car is perceived to be a better value.

The price of the four-door Jetta with automatic transmission is—don't flinch—\$8245. The four-door, five-speed is \$7870. The bargain basement two-door with five-speed is \$7650, and with automatic tranny it's \$8025. If you want the four-door with only three options—airconditioning, sunroof and alloy wheels—it will cost \$9280. For comparison, a loaded four-cylinder Citation is just a shade over \$8000, and is rated at the same 31 mpg as the Jetta with automatic.

In light of other cars that offer the same durability and reliable service as the Jetta—most notably the Japanese products—one wonders why VW economy is so expensive. **PM**



Racy version of the Jetta (there's a no-frills "stripper" model, too) features blacked-out window molding, urethane fender flares and a fully integrated front spoiler.

Portable generator puts power where it's needed



Plug it in and generator is ready to supply emergency backup power to your home.

The latest emergency power back-up system from Kohler makes it easier than ever to supply electricity where and when it's needed during brownout or blackout. Because the unit is portable, it can be hauled along to provide power at your summer home, too. The kit includes a connection box that mounts on an exterior wall, and a transfer switch that is installed next to the house service-entrance panel in the building being protected. Installation (by an electrician) takes about three hours.

Kohler Co. of Kohler, Wis. 53044, offers two heavy-duty models: One is rated 3500 watts, 42 amps., and the other 5000 watts, 42 amps. Both have 120/240 voltage capability. The kits are priced at \$1282 and \$1552 respectively, both with electric start and battery charger. They're available through home centers and yard-equipment dealers.—H.W.



Power is transferred from house entrance panel to generator via a safety interlock transfer switch located in a separate box.



WATCH THIS FOAM EAT GREASE.

See the difference with STP Foaming Engine Degreaser! It's all foam, no film formula eats through grease and grime. Safely cleans right down to engine surfaces. Stays where it's sprayed. Powers into grease, grime and dirt. Lifts them up. Even loosens grit!

Just spray it on. See its grime-penetrating formula blanket your engine



with cleaning power. See it cling as it cleans: it won't run off like kerosene-based cleaners.

Then hose it off. And take a look at clean. Right down to the surface. Engine looks great. Easier to work on. You can see exactly what you're doing. And there's no oily film to attract more grime. STP Foaming Engine Degreaser. All foam. No film. Try it.

ALL FOAM. NO FILM.

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A man in a cowboy hat and orange shirt sits on a dark horse with a white blaze on its face. The background is a dramatic, cloudy sky. The text "Come to Marlboro Country." is overlaid in the lower half of the image.

Come to Marlboro Country.

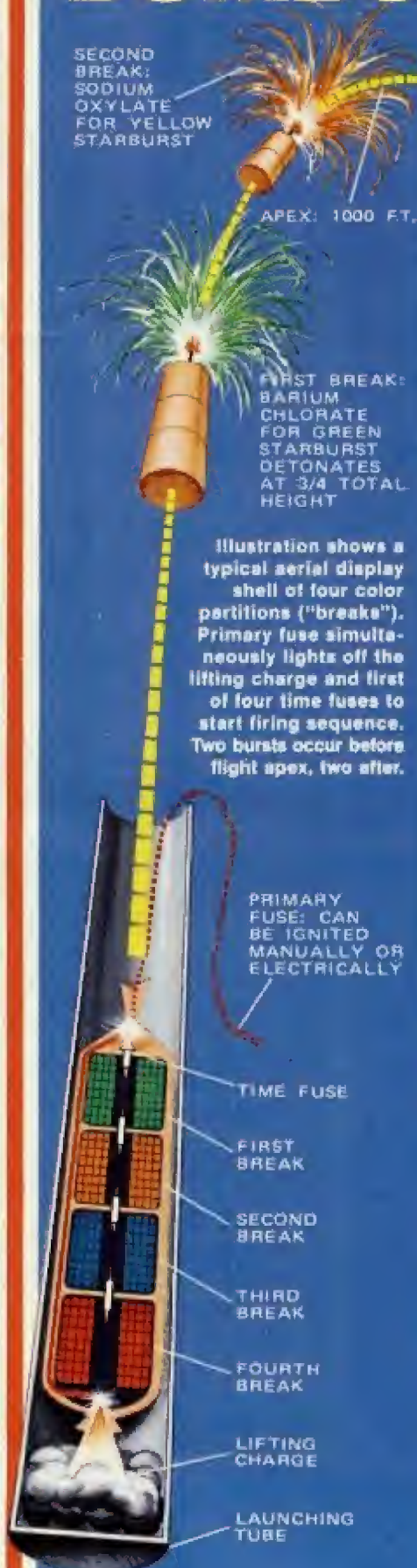


Marlboro Red or Longhorn 100's—
you get a lot to like.

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

17 mg "tar," 1.1 mg nicotine
av. per cigarette, FTC Report Dec. '79

BOMBS BURSTING IN AIR



The best fireworks are still made by artists, not machines, and the rockets' red glare still reflects a hand-measured pinch of tradition.

by Roy Bongartz Jr.

Every summer in the comic-opera city of Monte Carlo, some of the world's most tremendous aerial fireworks go on, or... off. It's a different show every four nights. Plain and fancy folk from many countries crowd the terraces outside the famous Casino to watch this annual International Fireworks Competition, which attracts fireworks makers from all over the

world. Last year, for the first time, an American firm won it.

The new champion is the New York Pyrotechnical Products Co. of Bellport, N.Y. The head of this family firm, which gained a fancy medal and \$5000 in prize money in Monaco, is a cheerful, 75-year-old Bellport native named Felix Grucci. His company, consisting mainly of his wife, two sons, daughter and

THE BASIC TECHNIQUES GO BACK 500 YEARS

son-in-law, had worked for six months, preparing materials to fill 90 cases of pyrotechnic shells and bombs for their big night against stiff competition from Italy, Spain, France and Denmark.

The Monte Carlo rule that every competitor must make all his own materials, as well as plan and execute the overall firing sequences, was no problem for Grucci, whose prize, with neat timing, crowned 50 years in the fireworks business. He clinched his victory last summer with a finale of 1500 shells shot off in five minutes, a dazzling bombardment that, he says, had boats radioing in from the Mediterranean to ask whether the city was on fire.

Grucci makes fireworks by hand, much as they were made 1000 years ago in China or 500 years ago in Italy, where the art was largely developed during the Renaissance. The story goes that the Chinese stumbled onto fireworks in much the same way they invented cooking—by accident. Saltpeter, widely used as salt in Asia, might have been spilled into a fire, where, combined with charcoal, it made bursting sparks. Add sulfur and you have gunpowder, the basic material of all fireworks, the recipe for which remains today 75 percent saltpeter, 15 percent charcoal, and 10 percent sulfur.

For an aerial burst, a charge of powder is placed at the bottom of a cylinder of kraft paper to provide liftoff. The top is filled with arrangements of lumps that look like

(Please turn to page 66)



At left, Felix Grucci Jr. (left) and brother Jimmy hold finished aerial displays—long fuses will extend from mouth of launching tube. Below left, Felix Sr. (left) and grandsons watch as Jimmy carefully packs a monster aerial "break." Smaller breaks (below) are handmade at the Bellport, N.Y., factory.





Medal emblematic of the world's fireworks championship won at Monaco by the Gruccis.



Hand operations like fuse cutting (far left) and sectioning of color "star" material into cubes are slow and tedious, but the Gruccis feel that both safety and overall quality could be compromised by the use of machinery in these steps. Workers cannot wear synthetic fabrics that might build up static electricity.

bits of coke (see photo on page 65), and have their own slow-burning fuse to set them off just as the missile nears the apex of its flight. These lumps contain carefully measured combinations of black powder and various chemicals that give different colors to the fiery sparks they make. Red, for example, is produced by sulfate of strontium.

Everywhere in fireworks manufacture and firing, timing is crucial. Grucci showed me how a length of plain black-powder fuse—a cloth sleeve filled with powder—will burn at a modest rate, about the speed of a man walking. Yet when he encases this fuse in a *paper* tube—in some of his rockets he uses paper penny and dime rolls, made to hold 50 coins each, that are just the right diameter and length—the fuse burns with an instantaneous *whoosh*. The idea is to keep the display bursts from going off until they're well up into the air—then you want them all to go off at once.

Individual fiery bursts of stars, showers, or sparks are combined in single shells with a varying number of stages, or "breaks," as they are called in the trade. Each break is made individually by hand by the Gruccis and their employees in a room the size of a two-car garage.

Theoretically a shell can have as many breaks as can be made to burn while the missile remains in the air. Most Grucci shells have three, four or five breaks, but the firm has put up special "bombs" with up to 10 spectacular blasts of colored lights going off in sequence—half of them while the shell is on the way up, the other half on the way down.

The way this is done can be seen in a cutaway diagram of a four-break shell (page 63). The chemical contents of each break vary according to the kind of firebursts it produces, but each break is alike in having an inner core of black powder with time fuses poking into it from top and bottom.

Simple and beautiful

The sequence of firing in such a shell is beautiful in its simplicity. The only point that isn't simple is that the burning time of each fuse must be exactly right in order to make that sequence work out; this is done by using great care in putting together the fuses and cutting their lengths.

A cylinder of four breaks, each break 3 inches high, is a foot long; the components are wrapped in an outer sheath of brown paper stiffened by a hand-rubbed impregnation of flour paste. From the top protrudes a long fuse which, once the

shell has been inserted in its launching mortar (a plain steel tube about twice as long as the shell it's meant to send up), will reach out of the mortar's mouth to accept a match or an electrically fired ignition charge.

The fuse lighted, two things occur at the same time. First, a fast-acting side fuse, moving its flame in a split-second flash, ignites a lifting charge of black gunpowder held at the bottom of the cylinder in a paper casing, which sends the shell as high as 1000 feet. Simultaneously, the original spark has ignited a time fuse in the top (first) break. This will set off a bursting charge that does three jobs in a split-second: It lights the color cubes packed around it, disperses them in a great globular pattern and ignites the time fuse inserted into the break just below it.

These color cubes are made of a powdered chlorate combined with one of a dozen chemicals producing

liance. The eye-catching "flitter" is made of aluminum, anemone and nitrates, while plain old sulfur is added to a cylinder of black powder to make the resounding boom and single bright flash that often makes an exclamation point at the last break of a shell.

Jim Grucci points out that an exactness in the amount of powder in the time fuse is as important as its length, because the temperature of the ignition charge can affect the quality of the color. He has determined, for example, that a heat of 2300°F. is ideal for producing the deepest blue fires. More heat than that tends to burn the color out of the chemicals, and a cooler fire fails to burn it completely. The chlorate that goes with all these color-producing elements forms a chlorine gas that has the effect of intensifying the color.

The Gruccis keep their use of ma-

'I love to see six months' work go up in smoke.'

various colors. This "star dust" is wetted down with a binding agent and stirred together to make a doughy substance to which a carefully measured amount of black powder is added. The resulting dough is molded into a 30-pound cube about 2 feet across and sliced into half-inch squares. Then, like trays of tiny brownies, the big squares are cut into half-inch cubes called "color stars" because when lighted they make all the colors of our fireworks.

The color stars can be dangerous if not handled and stored with care. A sharp blow can detonate one, while a spark can cause one to flare. In a four-break shell, each section carries about a pound, or around 900, of these color cubes—they are placed in each cylinder by the handful to fill out all the space around the fuse core. As noted, each bursting charge sets off the time fuse of the break below, so that the four charges go off in a neat order. The secret of this amazingly exact timing lies in making sure the fuses are cut *exactly* to the necessary lengths.

Fireworks makers have special chemicals they combine to make their magic fiery colors. Barium chlorate goes into green, paris green or black copper oxide into blue, cryolite or sodium oxylate into yellow and aluminum powder into white—passed through various meshed screens for different degrees of bril-

linery to an absolute minimum for safety and better quality. Jim Grucci notes some makers use a starmaking machine that eliminates all handwork of slicing those cubes of black "star" dough. He won't use one because he knows it might blow up some day; not only is there danger of a spark from metal clashing upon metal, but oil in a machine can combine with chlorates to form an explosive gas.

The possible permutations of color, shape, size and sequence of these fiery displays is limited only by the imagination and patience of their designers and makers. It is obvious what danger there might be in having part of one go off late, after it had fallen to the ground or onto a roof. Grucci figures 14 percent of the gross cost of any of his fireworks shows goes for insurance against damage claims by the public, but he says he never has any trouble.

One reason for his good safety record may be his development of the stringless shell. Conventional aerial shells needed the extra strength of twine wrapped around outside in order to contain the weight of the powder inside. However, when they exploded, the string sometimes caught fire, taking pieces of the burning shell down with it and constituting a fire hazard. Grucci uses cylinders of a heavier paper that hold up without the string. On explosion, however, they burst into

(Please turn to page 124)

Flying truck



Ernie Hawk needed something faster than a truck and cheaper than a freighter plane to ship his products. So he designed his own STOL "flying truck," the GafHawk 125. A boxy fuselage and undertail access make loading efficient; a single engine reduces costs. A 54-percent-scale wing, tail and landing gear are being flight-tested on a rebuilt Piper Tri Pacer (left). The wing incorporates so-called Rollerons, a combination of spoilers and ailerons, which operate on the upper wing surface between wing and flaps. They're said to aid cruise performance and STOL ability. GafHawk will cost \$550,000, about \$1 million below its nearest competition.

Space camera

Space-shuttle astronauts will be using a slightly modified Nikon F3 to take pictures up there. Nikon claims a standard F3 body passed most of NASA's reliability tests, but that a special lubricant was needed to combat lube migration in zero-gravity. A bulk-film back and a heavy-duty motor drive attach to the body, and some controls are oversize for gloved hands. The whole package is coated with paint that will not outgas in space.



Without a scratch



It's not unusual for transit buses to be washed, but the windshield on this bus makes an automatic bath possible. Unlike most plastic windshields, it is almost as resistant to scratching and abrasion as glass; so rough brushes can be used. Made of General Electric's Margard—basically Lexan polycarbonate with a special silicone-based coating—it can be washed with relative impunity. Margard is said to be unbreakable and to weigh half as much as glass. Used mostly on trains, buses and construction equipment, it may soon find its way onto cars.

Driving the Rover 3500

FIRSTHAND REPORT

by Michael Lamm
WEST COAST EDITOR



To me, the Rover 3500 sedan looks the way GM's X-cars ought to. And it's true that designers of the Citation and Phoenix five-doors studied the Rover several years ago.

BL Ltd. introduced the contemporary Rover 3500 in England in 1976. In its British form, the 3500 looks even sleeker and more sophisticated than the U.S. version. For example, the domestic model has rectangular headlamps behind glass lenses and the steering wheel is of a more futuristic design—much more in keeping with the “podular” instrument cluster used in both U.S. and domestic versions.

In England you also get a choice of three engines: two versions of an ohc in-line Six (2300 and 2600 cc) plus the 3.5-liter aluminum V8. The car, though, was designed for the V8.

Over here, Jaguar Rover Triumph (JRT), the U.S. arm of BL Ltd., hopes to sell the Rover 3500 as a “specialty car” (their term)—an automobile combining styling, performance, handling, luxury, roominess and comfort in one notable package.

Long on standard extras

I think the Rover fills that bill admirably. There's a standard-equipment list as long as your arm. Not since the 280-ZX have I been so im-

The TR8 and Rover share the same 3.5-liter V8 (right), but the TR8 version uses twin carburetors instead of Lucas-Bosch fuel injection. The TR7 interior, one of the nicest in any two-seater, remains unchanged in the TR8 version (below). It's roomy, comfortable and well-appointed. Although the V8 engine adds 100 pounds to the nose, compared to the TR7, the handling hasn't suffered a bit. It still corners flat and responds quickly.



The Rover interior (right) lives up to its price tag: It's roomy, and high-quality materials are used throughout. Every gauge in the dash has a backup warning light should the gauge malfunction. Sloped nose and wedge-shaped turn signals remind us of the Ferrari Daytona. Four-door layout makes it easy for rear passengers and handy for unloading cargo when the rear seats are folded down. Rear shocks automatically adjust ride height.



and Triumph TR8

pressed by the staggering assortment of standard extras.

The 215-cu.-in., fuel-injected, aluminum V8 runs very smoothly and in extreme silence *except* for the fan. Why BL engineers let such a noisy viscous-drive fan get past them I can't imagine.

The car performs well, too, with willing acceleration and generally good passing reserve. I'd estimate the Rover's 0 to 60-mph time at right around 10 seconds, which beats most five-passenger sedans of the past five years.

I found the manual-transmission Rover noticeably quicker than its automatic cousin. The Borg-Warner

three-speed automatic is one of the Rover's few optional extras, and frankly, I can't recommend it. It's sluggish and rough-shifting when you compare it with the five-speed transmission.

The manual gearbox shifts smoothly and well, uses tapered roller bearings and has its own built-in oil pump. The only fault I could find with it was the spacing between second and third. It's too big a gap, and lies in a critical speed range at around 40 to 50 mph. Other than that, though, I can't fault it, and top gear—an 0.83:1 overdrive ratio—makes high-speed cruising quiet and economical.

The aluminum V8 used in the Rover is the same unit that was manufactured for the 1961-63 Buick Special and Olds F-85 by Doehler-Jarvis of Toledo, an independent supplier to GM and other carmakers. In the Doehler-Jarvis casting method, steel cylinder liners were held in place and the aluminum poured around them.

Today, Rohr Aluminum in England casts this engine in a slightly different way. The block is poured minus liners; the steel sleeves are pressed in later. The heads are aluminum, too, as they were when Doehler-Jarvis made this engine.

(Please turn to page 141)



Tough new blowups that save on storage and fuel

These versatile lightweights inflate to go farther with less horsepower.

by Bill McKeown
BOATING EDITOR



Even in a mini-camper, there is room to stow a deflated Zodiac and Merc 40 outboard without the need for a cartop or trailer. Launching blowups is quick and easy at any lakeside.



New blow-up boats are being fitted with forward steering for motors 20 hp and up.



A Semperit made of light Kevlar fiber won last fall's first inflatable race in Miami.



Much more than rubber dinghies and liferafts, the new inflatables, like this Zodiac, can handle big motors, tow water skiers, perform like runabouts.



Stability and low sides of inflatables, like this Boston Whaler, make diving much easier.



As a workboat, a big 17-foot Avon mounts an Evinrude 70 and can handle up to 120 hp.



With an Eski 7.5 motor astern and an electric forward, Sevylor's XK330 is a bass boat.



Beaching is easiest with new, lighter, abrasion-resistant inflatables. Oval-shaped Sevylor Caravelle adds bracket for 2-hp outboard and also has an optional sailing kit.

Puff-up boats have been around a long time, but recently many small-craft buyers have been taking a second look.

What they've found are second-generation craft that have jumped ahead in performance, durability and cost. One look at the \$1000-up price tags will convince any shopper that these are no longer rubber and plastic toys to play with in a pool. Some of today's models use light, space-age materials to make them more rugged and portable, V-bottom designs for a more comfortable ride, and construction that can handle bigger outboards than ever before. A new Inflatable Boat Assn. now lists 18 companies that make or import them.

Like the European appreciation for small cars, the inflatable fad is also moving westward across the Atlantic. On the Continent, blow-up boats used to be called "Zodiacs," after that popular brand, no matter who made them. Here, they were often called liferafts, as a result of thousands of war-surplus models that were dumped on the market. Choices now, however, include imports and excellent American-made boats that range from single-seaters up to big river-running rafts that can carry a crowd.

Tough fabrics that can resist scraping against barnacles and rocks helped popularize the craft as shore-patrol and surf-rescue boats, and as dinghies that could bang up alongside a yacht without scarring the topside. Newest models may incorporate graphite fibers or DuPont's Kevlar aramid (similar to those used in bullet-proof vests) to add great strength while sometimes decreasing weight. Neoprene, Hypalon or PVC coatings over nylon fabric are also popular to provide puncture and abrasion resistance. Electronic seam sealing and new adhesives have also made it possible to seal in transoms that can mount outboards up to 120 hp.

The well-made inflatable is almost impossible to sink, which is why it makes such a good liferaft. However, it can be capsized—although the latest survival rafts have been redesigned and provided with underwater ballast to maintain upright flotation in

(Please turn to page 145)

Those automatic cameras—

Combined with the new auto flashes, they eliminate most of the work of taking good pictures.

by Ivan Berger

Cameras aren't yet so automated that they tell your subject "Say cheese!" But the day when that will happen draws closer all the time. The newest cameras can not only control daylight and available-light exposure for you, but can let you choose how they'll control it. Not only that, various new models can:

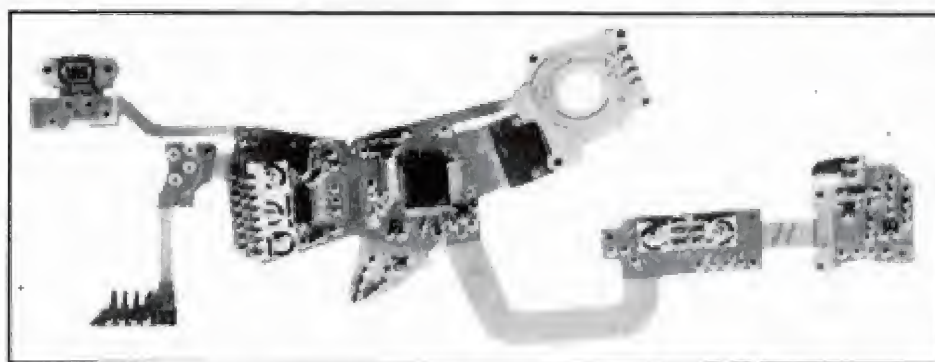
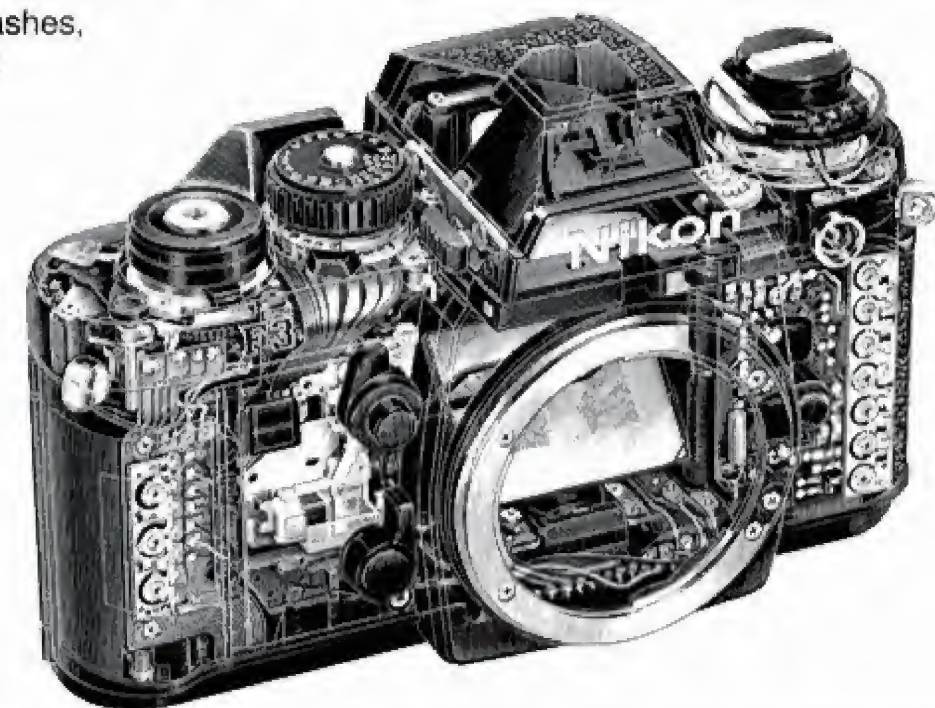
- Focus themselves.
- Beep when batteries are low.
- Beep when film is running out.
- Wind themselves.
- Print time and date on the film.
- Control flash exposure by keeping up a running dialogue between the camera and flash gun.

If that sounds like a computer at work, you're right. The new automatics have built-in microcomputers that are more powerful than earlier control systems.

The computers are helping to keep camera prices down while increasing reliability. Complex electronics, unlike complex mechanical control systems, are cheap to manufacture and assemble, which helps hold the line on inflation. (Other techniques, including the use of high-impact plastics, also help.)

Since solid-state electronics don't wear out the way mechanisms must, there's greater long-term reliability, too. But along with that come two short-term catches: Electronic components sometimes fail shortly after purchase (covered by warranty, but still a nuisance). And battery failure can put a whole camera—not just its metering system—out of commission, or at best, leave it limping along on only one or two shutter speeds. (Moral: Always check batteries before shooting and carry spares on trips.) But the most obvious benefit of computerized cameras is increased control-system versatility. Take flash automation, for example.

A lot can go wrong with flash. If the camera's shutter speed is too fast, part of the film won't be exposed while the flash is on. If you shoot before the flash has recycled, the flash will be weak or not go off at all. If flash output, subject distance



Cutaway of Nikon F3 (top) shows complexity of modern automatic SLRs. Flexible printed circuit from Contax 139 (above) typifies quartz-oscillator-controlled microcomputers.

and lens f-stop don't match, the picture will be too light or too dark.

Auto-flash guns, which measured the light bouncing back from the subject in order to know when to shut themselves off, were a partial solution to the last problem. But that still left room for error if you forgot to set the f-stop right—not to mention all the other problems. But new cameras—and "dedicated" flash units (designed to interact with specific camera models)—are taking care of all that.

Sophisticated flash controls

On the Olympus OM-2 and OM-2n, the Contax 139 and 137 MD and the Nikon F3, the signal to shut off the flash comes from a light sensor in the camera reading the light bouncing off the film. That means there are automatic corrections for f-stop settings, filters, close-up extension

tubes or bellows and any other factors affecting the light reaching the film.

What happens if the flash can't deliver enough light (if the distance is too far, or the f-stop too small, for instance)? Some of the new automatics will just keep their shutters open long enough to complete the exposure from the available light; others will blink indicator lights in their viewfinders to warn you something is wrong. The same lights double as "ready" lights to tell you when the flash has recycled. If you try to shoot before the flash is ready, most auto cameras will simply shoot an auto exposure as if the flash weren't there.

Too fast a shutter speed? No problem. On most new automatics the unit will automatically set the camera's shutter to proper flash sync speed when it's ready to shoot—but

more versatile than ever

will relinquish control to the camera while recycling.

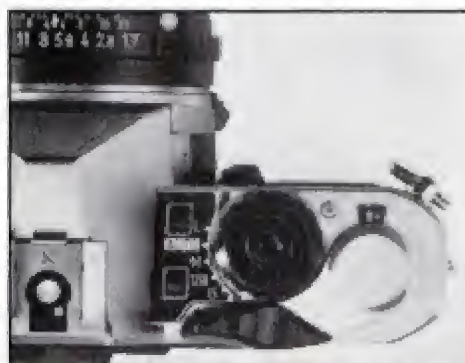
Just about every major camera manufacturer makes such dedicated flash systems for at least some of their models. You'll find units for Canon, Chinon, Contax, Fujica, Konica, Mamiya, Minolta, Nikon, Olympus, Pentax and Ricoh models. Those flash guns can't usually be used on cameras designed for other dedicated-flash cameras, though they can be used as ordinary auto-flash on other cameras.

If you have several cameras designed for different auto-flash systems, take heart: the Sunpak Auto 522, Auto 422D and Auto 222D and the new Mecablitz 60CT2 flash units have adapters available for dedicated use with most of the cameras listed above. Other multicamera models are on the way from Braun and Nissin.

The Sunpak 522 and Mecablitz units both offer options that the camera makers don't match: a vari-



Olympus ringlight (above) gives even light for close-ups, is controlled by sensor in camera. Cross section of Nikon F3 (bottom right) shows light path to internal flash sensor. Sun-pak module (top right) adapts the same flash to different cameras.



Change shutter speed manually on Pentax ME Super (top left) with two pushbuttons; no dial needed. Canon AF35M (top right) has autofocus, auto film advance and re-

wind. Fujica AX-5 (lower left) features dual-mode automation, two-head flash option. Mamiya ZE (lower right) couples lens to auto system electrically.

ety of power sources (Mecablitz even has a charger for use in the car) and telephoto range extenders (plus a small, umbrella-type reflector attachment for the Mecablitz).

Olympus's latest flash system is versatile, though. There are now three flashes in the system: the small T20; the larger, new T32, with built-in bounce; and a ringlight that fits around the lens for shadowless, close-up shooting.

But what of all those other autocamera wonders? They're here in force. Take auto-focus, for example. When PM covered it in May '76, the first commercial autofocus cameras were still on the drawing boards. Today, Canon, Chinon, Fuji, Konica, Minolta and Yashica have 35-mm compact cameras with autofocus, Polaroid has its two Sonar models, and autofocus movie cameras are available from Bell & Howell/Mamiya, Elmo and Sankyo, among others.

Polaroid's SX-70 and Pronto cameras were also among the first to have built-in motors to wind the film and, in the SX-70, to operate the reflex mirror. Now there are two 35-mm reflex cameras, the Konica FS-1 and the new Contax 137 MD, with built-in auto-winders, and today add-on auto-winders are available as accessories for most 35-mm reflexes.

Motorization makes remote con-
(Please turn to page 145)

"I decided on the Caprice for two main reasons," jotted a California farmer. "First because of its good looks, and second because I could get the car with a V6 engine."

This V6, new for the 1980 full-sized Chevrolet, gave the farmer 20 mpg in town and 24 on the highway. "Where else am I going to find a big car with that kind of mileage?" he mused.

Perhaps he should consult with a New York physician, owner of a Caprice four-door wagon. The doctor told us, "I think that if a big family needs a station wagon with good cargo space, the only solution

PM OWNERS REPORT: CHEVROLET CAPRICE

These two engines—the V6 and the Olds-supplied 350 diesel V8—put Chevrolet's big cars in a different light. According to PM's survey of 1000 Caprice owners, the V6 averages 17.1/22.0 mpg—which is not quite what the farmer got, but very praiseworthy nonetheless.

Unfortunately, our diesel sampling wasn't large enough to tabulate, but the few diesel owners who responded sounded mighty happy with their mileage.

Are there any disadvantages to these two engines? A California school administrator answers: "The only inconvenience with the V6 is that you have to downshift on long highway grades, but I expected this when I bought the car."

"The diesel is a little noisy at idle speeds, but once you're under way the

car is very quiet," said a North Carolina engineer. And an Illinois farmer brought up the point that Chevrolet should make the diesel V8 available in all body styles, not just the wagon.

Owners of Caprices with the 4.4- and 5.0-liter V8s were also generally satisfied with their engines' performance and economy. A minority—8.5 percent—wished they'd get better gas mileage, and a few complained of engine roughness. A Tennessee attorney mentioned, "The 4.4-liter motor has been a little rough at times, due to pollution equipment. I am told this will correct itself with additional mileage, and it is better now than when I first got the car."

The Caprice's comfort, ride and handling got a lot of applause. A New Hampshire salesman, for example, commented, "I believe this is a better-riding



Caprice hood slopes more for '80. This, plus other modifications, adds 3 mpg.

to the fuel problem is a diesel engine." He reported getting 18 mpg in town and up to 29 mpg on long trips. "Although I haven't achieved the EPA averages of 21 city and 30 mpg highway," he said, "I'm satisfied with the mileage I do get."



Owners praise seating comfort, but would prefer handier power-window lift switches.

BY MICHAEL LAMM WEST COAST EDITOR

They love the looks, room and mileage. However, the automatic transmission could be better

Quad halogen lamps deliver 750,000 candlepower.

Most buyers opted for 264-cu.-in. V8 engine.

Sloping hood gives better view, improves the aerodynamics.

Improved design reduces wind noise around windows.

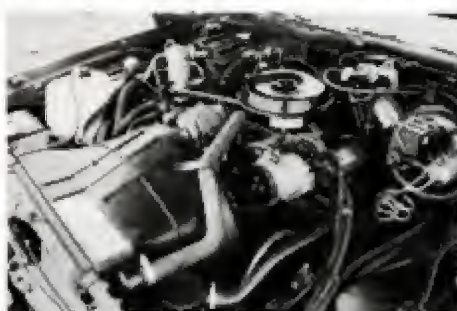


car than the Buick Electra or even the Cadillac de Ville. It's less bulky and handles magnificently around corners."

"Roomy," opined a California accountant, and a Minnesota truck driver noted, "Luxurious interior." And an Ohio sales assistant: "Rides beautifully, is very quiet. I'm very happy with my car."

On the few occasions when owners did voice complaints, they tended to be minor and fairly isolated. For example, 62.3 percent of our respondents had experienced no mechanical troubles. Nearly 80 percent ranked workmanship *good to excellent*—a rate of satisfaction higher than was expressed by 1980 Seville owners! And roominess front and rear also scored quite high—96.0 and 92.3 percent *good to excellent* respectively.

One persistent gripe, though, centered on the torque-converter lockup in the au-



Drivers get 17 to 22 mpg for V6, but wish diesel V8s weren't for wagons only.

tomatic transmission. Around 35 mph in town, the lockup cuts in and out incessantly—a quirk that annoyed a vocal minority.

Another annoyance centered on the driver's power-window switches. They stand low on the door, out of sight and hard to reach. A Texas salesman summed it up for many when he rasped, "The electric-window controls could be put in a more convenient place. And almost anywhere else would be more convenient."

Chevrolet's sales staff received a higher rating in our survey than its service people. Some 84 percent of our owners rated their dealers' sales personnel *good to excellent*, while dealer service came in at 73.9 percent (*good to excellent*). Here are representative comments.

"The salesman was very courteous," wrote a North Carolina trucker, "and gave us a good trade-in allowance. But this dealership is understaffed in its service area, which means long waits for warranty repairs."

A self-employed Californian: "The salesman was efficient and honest in his dealings. There's trouble in the service department, but the problem is as much with Detroit as with the local dealer."

A retired Michigan chemist: "This salesperson didn't seem to have much interest in whether I bought the car or not

(Please turn to page 146)

Big Chevy less heavy

Chevrolet downsized its big cars in 1977, shedding about 700 pounds and gaining some 3 mpg.

The Caprice and Impala still share bodies, and both pick up an additional 3 mpg for 1980 by a combination of refinements. They include a more sloping hood, rounder body sides and deck lid, the paring of another 100 pounds, high-pressure radial tires, plus a lockup torque converter in the automatic transmission. This lockup prevents slippage in high range above 35 mph.

The in-line Stove-Bolt Six bowed out after 1979, ending its uninterrupted half-century run. In its place come two lighter, more compact V6s—a Chevy-built 229-incher and the Buick 231 V6 for California only. Chevrolet also offers the 267-cu.-in. (4.4-liter) V8 as standard in wagons, or optional in coupes and sedans.

The optional 305 V8 (5.0-liter) continues, and a 350 diesel V8 (5.7-liter), supplied by Olds, may now be ordered in station wagons only.

The Caprice comes fully equipped with automatic transmission, power steering, power disc brakes, hidden wipers, day/night mirror and bright moldings. The Caprice Classic adds special trim plus a clock, extra insulation and dual horns. And the Classic Landau coupe gets a vinyl roof and wire wheelcovers.

Caprice prices begin in the neighborhood of \$7150 f.o.b. When fully optioned, the price can reach \$10,000. Compared to some imports, this seemingly high price tag is very competitive.

A NATIONWIDE SURVEY BASED ON 551,374 OWNER-DRIVEN MILES



A 20.9-cu.-ft. trunk and 25-gallon tank make Caprice a natural for long-distance family or business travel. Styling is the car's most powerful selling point, and most owners chose four-door models.

Rounder body sides and deck lid also contribute to mileage.

Lockup torque converter needs improvement, owners say.

High-pressure radial tires roll more freely.

NOW: MINI TVs ARE ENTERTAINMENT CENTERS

These tiny take-alongs offer more than TV on the beach. Some have AM/FM radios, cassette players, even shortwave receivers. And their picture quality is good!

by Neil Shapiro ELECTRONICS EDITOR

Television sets are smaller, more portable and offer far more extra features than ever before. These little sets, whose picture tubes measure only 5 inches or less diagonally, combine TVs with shortwave radios, cassette tape players, clocks and AM/FM receivers.

All the AM/FM tuner sections we heard sounded good. Even if there's nothing on the tube, you can still enjoy these TVs! The shortwave radios, however, were a different story. The built-in antennas are not sufficient for really good shortwave reception.

Brightness and clarity characterize these small sets.

Battery-powered, little TVs will take to the beach this summer, so you can get a tan without missing your favorite shows. Our lovely miss is watching a Unisonic model 967 color set with a built-in multiband radio and on-top cassette recorder.





Two entertainment centers from Hitachi are the color CK200 (top) and the black and white K/2400 (bottom). Both of them are battery portables, and the 2400 also offers radio and cassette.



Part of its "Toteable" series, Quasar's model XP145RJ (above) offers an AM/FM radio. Below are Unisonic's models 955 (top) and 927 (bottom). The 955 is a battery-powered color set, while the 927 is black and white, featuring a multiband radio and a built-in cassette deck.

Even the smallest pictures are viewable, and some are remarkable.

An engineer would call this brightness an illusion. The picture tubes are really no better than the big ones, but the dots that make up the picture, being compressed onto a smaller screen, appear to make brighter images.

Sunlight will wash out the screens, however, so take along a good beach umbrella. (Due to the bright sun we had for our beach shots, we photographed the TV screens in a studio, and then stripped the pictures back into the sets.)

PM



The cute handful above is Panasonic's TRP-1000 TV with one-inch b&w screen and AM/FM radio. At right (clockwise from top) is JVC's CX500 color set with AM/FM and cassette; JVC's tiny P-100AE with AM/FM and two-inch b&w screen; the Panasonic TRP-1000 also shown above; and Sampo's b&w model B704 with AM/FM radio and cassette deck.



PM designs your personal word processor

WITH A HOME COMPUTER, AND FOLLOWING OUR DESIGN INSTRUCTIONS, YOU CAN HAVE A WORD PROCESSING SYSTEM THE EQUAL OF A BIG CORPORATION'S -- FOR A RELATIVELY SMALL COST.

BY NEIL SHAPIRO electronics editor

Imagine a super typewriter that corrects errors without any need for fluid or erasers. It instantly re-types a whole report to make room for a last-minute addition. If you want to find a certain word buried in the text, the typewriter itself points out what you're looking for.

But it isn't magic; it's a computer. It exists right now. Such a system, called a word processor, ties a computer together with a video display and a printer.

For years, big businesses have used these processors to generate reports, form letters, mailing lists and all printed materials. But the cost has always been enormous—from \$15,000 all the way up to and beyond \$50,000.

Welcome to the computer revolution. PM has assembled a word-processing setup that anyone can put together and use for under \$3000.

Our system can be used by church groups, bowling leagues, Mom and Pop businesses, schools, and even private individuals, because the cost is relatively low.

The video blackboard

Word processing replaces the typewriter and paper with an instantly correctable computer display. As you type on the computer's keyboard, your text is displayed on the screen of a television set or video monitor.

If you make a mistake, there is no need to erase. Simply hit a few keys

and the new words replace the old. There are all sorts of other software-dependent features we'll get to shortly.

Just keep in mind that in word processing the printed version comes last—after you have completely corrected everything on the video display to your own satisfaction.

Our system is dependent on the popular Apple II computer with disc drive. We chose the Apple for two reasons. First, we like the word-processing programs we saw for the Apple the best. It is these programs that turn the Apple into a word processor. Second, we were able to find an inexpensive way to get readable low-

Putting together your own word-processing system is easy. Many computer stores stock all parts, software and hardware you'll need. We show you how to put them together.

DISK II
DISC DRIVE

HEATHKIT H-14
LINE PRINTER

APPLE II
PERSONAL COMPUTER



er-case ("small") letters on the Apple's display.

There are word-processing programs for other small computers, notably for the Radio Shack TRS-80. However, we decided not to confuse the issue and concentrate on the Apple II.

The software

Computers don't know how to play Star Trek, balance your checkbook or process words until you feed them a program that tells them how to act. When you discuss what a computer does, you are really talking about the program or software.

For the Apple II, we have found two fantastic word-processing programs. The first is "Super Text" from Muse Inc., and the second is "Apple PIE Version 2.0" from Programma International. They have these features in common:

■ **Lower case.** With the use of the Dan Paymar lower-case adapter (see manufacturers, page 120), the computer will show text on the video screen in upper and lower case. This, we feel, is a necessary feature for everyone but the dyed-in-the-wool computer hobbyists, who are accustomed to looking at only the capital letters.

■ **Wraparound.** What cuts down on a typist's words-per-minute speed more than anything else? The need to hit a carriage return every time the end of a line is reached. These programs do away with carriage returns.

The computer sees if the word you have typed will fit onto the display line. If it will not, the word is automatically moved down to the beginning of the next line.

■ **Insert/delete.** If you've made a mistake and type "the" as "te," there is no more need for opaquing fluid. You can move back and insert the letter.

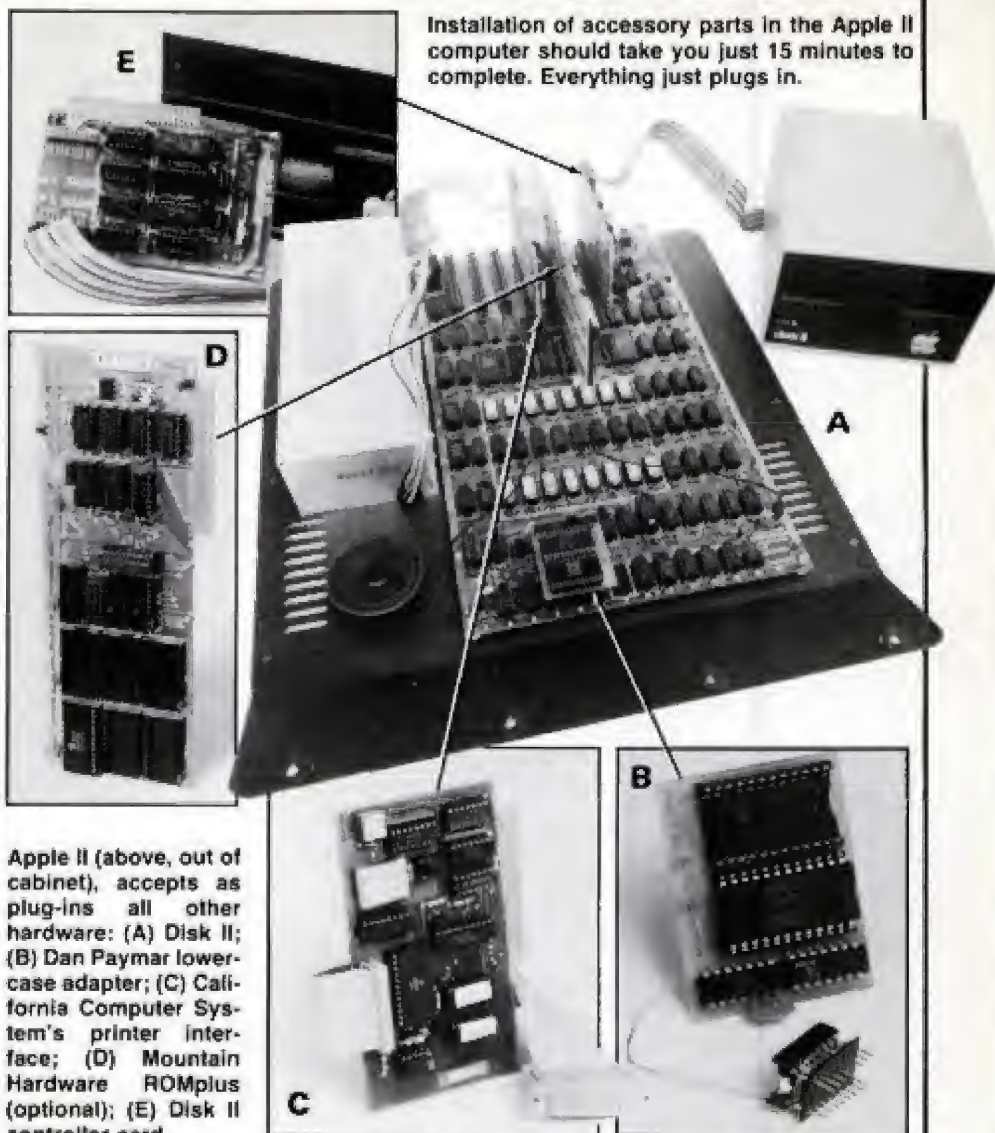
The same principle can be used to insert words, sentences, even whole paragraphs, within a body of text. There's no more need to retype a page in order to add something.

Deletions can be accomplished the same way. Again, whether letters or words, sentences or paragraphs, the text display is instantly adjusted to compensate for your corrections. The first time you insert or delete and watch the text move about, it will seem like magic.

■ **Replace and find.** Suppose, for example, you have a 300-page report concerning a subsidiary company called XYZ Inc. If the name changes to ABC Unlimited, you no longer have to retype all 300 pages. The word processor will automatically

(Please turn to page 120)

Follow PM's word-processing recipe



Apple II (above, out of cabinet), accepts as plug-ins all other hardware: (A) Disk II; (B) Dan Paymar lower-case adapter; (C) California Computer Systems' printer interface; (D) Mountain Hardware ROMplus (optional); (E) Disk II controller card.

A word-processing system can help keep your business in the black. Here is a part-by-part summary of what we recommend. Check our list of manufacturers (page 120) to buy or write for information.

Apple II (\$1195 to \$1495): This is one of today's most popular microcomputers. It is the base for our entire system.

Disk II (\$595): This is the matching disc drive for the Apple II. It can store and retrieve data quickly and reliably. The software we recommend requires its use.

Software: Super Text from Muse (\$100) and Apple PIE Version 2.0 from Programma (\$80) are the two best word-processing programs we have seen.

Printer card (\$125): Our system makes use of the Asynchronous Serial Interface card from California Computer Systems and Hobbyworld. Don't substitute other interface cards unless you are absolutely certain they will work with your system.

Printer (\$595 in kit form): We used the Heathkit H-14, a printer capable of very high speed when used with an interface such as the one above. In kit form, it is surprisingly cheap, and it's still relatively inexpensive when purchased already assembled. Print quality is good, but you may wish to substitute a better (although much more expen-

sive) printer to get typefaces like those found in books. *Make absolutely certain the printer functions with the rest of your system.*

Lower case (\$50): We considered the ability to put both upper and lower case (capital and "small") letters on the screen a must. The Dan Paymar lower-case adapter plugs right into the Apple II in a matter of minutes. Not only does it give lower-case letters; it adds other features to the Apple II that will be handy if you do any programming.

Miscellaneous: An accessory not used in these word-processing programs but which you should consider is Mountain Hardware's ROMplus card. With it, you will find putting labeled charts on the computer's screen is easier; you will also have multicolored-text capabilities and very advanced editing features during programming.

One annoying feature of the Apple II is a reset key that, if accidentally pressed, interrupts your work. Softape makes a device to "turn off" that reset key.

The bottom line

For \$2670 to \$2970 (depending on what Apple II you buy), you will have a word-processing system competitive with much more expensive ones. Computer technology is now within your business' reach.

How the new Homebuilt

Thanks to new materials and construction techniques, plus new compact powerplants, building your own airplane has almost become an exercise in instant gratification.

by Harvey Shaman

Ultralight is the loosely applied term for aviation's current rediscovery of itself. It may cover everything from Dracula's cape stretched over a strut, with a Mixmaster boost, to a tiny, but perfectly formed airship having three-axis control, landing gear and other amenities, plus a powerplant fully capable of getting it off the ground and back on again. The same aura of excitement and adventure surrounds the field today as it did 70 years ago, when others were building similar airplanes with fabric-covered wings and wirebraced structures.

Yet today we have far better materials: time-proven metals, cables and fasteners, as well as such developments as polyvinylchloride (PVC), urethane, Styrofoam-and-fiberglass construction,



FLAC (left) is a wing-and-pod design available in two kit forms: One has only fuselage pod and wing leading edges premolded, takes builder about 150 hours; second has more ready parts, needs 60 hours.

Mitchell Super Wing (right) is powered by 10-hp go-cart engine, has three-axis control. Kit is based on classic aircraft-building techniques: The Dacron-covered wing is made with wood spar and "D" tube with spruce ribs.



ultralights take shape

A popular ultralight engine is the 10-hp West Bend mill mated to a long shaft.



Gemini chainsaw-derived system shows the attention paid to powerplant development for ultralights. Adaptable to different types of aircraft, it is sold only in twin configuration, with 6-hp units mounted outboard from pilot on booms.



PM photos by the author

Hi-Nuski (left) has unique full rudder and aileron movements activated by pilot shifting his weight (weight shift alone controls climb and descent). The 120-pound (empty) aircraft is sold in ready-to-fly condition.





Lazair is a high-wing monoplane design with twin 5.5-hp chain-saw engines on the wing's leading edge. Aluminum (tube) pilot's cage and landing gear are suspended under the Dacron-covered wing. Tail is an inverted "V;" mixer stick couples ailerons, elevators for three-axis control.

carbon fiber and Kevlar fabrics plus a variety of epoxy resins. All lend themselves to the construction of aerodynamic shapes having low weight, high strength, reasonable cost and ease of fabrication.

Up to now, there has been virtually no federal regulation of ultralight aircraft—either the building or flying of them. Those involved in the sport would, of course, like to keep it that way, but some kind of relationship between the Federal Aviation Administration and the manufacturers and builder/owners of ultralight aircraft seems inevitable.

One of the problems such a relationship might resolve has to do with the presently very gray area of where *unlicensed* ultralights leave off, and *licensed* ultralights begin. There is now a tacit understanding that if the pilot can pick an airplane

up and foot-launch it, it is unregulated. If not, it should fall into the experimental category and is subject to the full range of regulation, including FAA inspection for structural integrity.

This further hinges on FAA Advisory Circular 20-27B (1972) which states that the homebuilder must construct the "major portion" of the aircraft in order for it to be licensed in the experimental category—although the FAA doesn't specify exactly what a major portion might be. If it takes you longer to put a kit together than it took the manufacturer to make the parts he sells you, you should be able to claim you built the major portion. If this were *not* the case, you could only buy the kit after the aircraft had been certificated, a costly testing and proving process that would immediately drive the majority of ultralight aircraft designers out of business.

Hedges against further encroachment of regulation have gone so far, in the case of one manufacturer, as to have proven "foot-launchability" with the installation of a special harness and a folding seat, then recommending "wheel launches" (on the landing gear that comes with the

plane) to people who buy it. Remember, licensed aircraft (even in the experimental category) require the operator to have at least a student pilot's license (with instructor's okay to solo), but unlicensed aircraft require nothing but the nerve. And if one area of growing concern is the somewhat spotty ultralight safety record, the fault has been not so much with the way the planes are put together, as with the lack of knowledge, skill and judgment shown by builders turned pilots.

Yet the ongoing evolution in designs, construction techniques (see opposite page) and adaptation of low-horsepower, nonaircraft engines (both two- and four-cycle) is bound to put many more of us in ultralight airplane cockpits in the near future. In the past, building your personal airplane at home required a commitment in years, energy and funds that eliminated many of us who had dreamed of it. But unfettered by regulation, so far, ultralight designers have produced plans and kits that enable us to produce an affordable private aircraft—that flies just like the bigger ones do—over a matter of weekends.

Powerplants are still a problem area, however. Only two manufacturers, Continental and Lycoming, are building engines for the general aviation market, and the smallest available from either is a 115-hp,



Minibat is a flying-wing sailplane powered by a 3-hp "sustainer" chain-saw motor buried in its fuselage (the prop measures 19 in., rotates in slot between fuselage and rudder), following a bungee-cord launch. The kit offers premolded parts.



four-cylinder Lycoming, which is both too powerful and too expensive for many smaller homebuilt plane designs. One of the problems in adapting existing nonaircraft engines is a liability factor: As soon as a designer indicates he wants to use a nonaircraft engine as the basis for an airborne system, the manufacturer—afraid he will be held liable if something goes wrong—is reluctant to sell him engines.

Yet numerous engine conversions, kits and complete flyaway packages are becoming available for light aircraft in higher horsepower ranges; two using half of a Volkswagen engine, one a Kawasaki motorcycle conversion, another based on an 18-hp Onan industrial engine.

For ultralights, specifically, there are two two-cycle, air-cooled engines for low-rpm, direct-drive use in aircraft: the Chotia and Ultralight. The Chotia is a 25-hp, single-cylinder, 32-pound mill designed to turn a 44-inch prop at 4500 rpm, which should give the engine a fairly long life—Chotia predicts 500 hours between overhauls. Initially designed for the Weedhopper ultralight (see *Ultralights: They're Re-inventing the Flying Machine*, page 87, Mar. '79), it is available for other aircraft. The Ultralight, a two-cylinder engine swinging a 48-inch prop at 4500 rpm, basically weighs 30 pounds. A recoil or electric starter will increase its weight only slightly.

Many powerplants on ultralights are off-the-shelf units designed for chain saws, snowmobiles and other machines fitted with a reduction gear and, perhaps, a tuned exhaust. Lazair's Scorpio is an adaptation of a 6-hp Pioneer industrial chain-saw engine. The Gemini is a built-up powerplant using basic components from a European chain saw, plus parts from several makers. Perhaps the most widely used is the adaptation of the 10-hp Chrysler 820 West Bend engine by Soarmaster, with chain-and-sprocket reduction (to 2900 rpm) and prop shafts to 10 feet long and tuned exhaust optional.

Amid all this buzz and flutter, the Wright Brothers would undoubtedly have felt at home.

FM

For more information on . . .

Mitchell Wing Model B-10 (on the cover) and Super Wing: Mitchell Aircraft Corp., 1900 South Newcomb, Porterville, Calif. 93257.

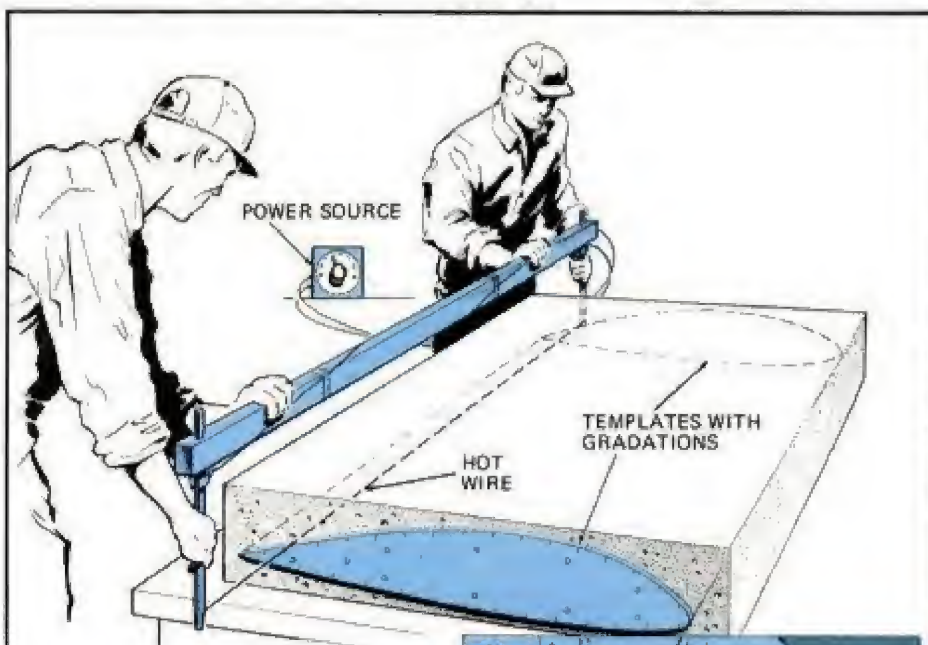
FLAC: Striplin Aircraft Corp., Box 2001, Lancaster, Calif. 93534.

Hi-Nuski: Southern Air Sports, Box 253, La Place, La. 70068.

Gemini: Sky Sports International, 655 Juniper Hill Rd., Reno, Nev. 89509.

Lazair: Ultralight Inc., 6 George St., Port Colborne, Ont. L5K361.

Minibal: GLA Inc., 315 Oldfield Rd., Downers Grove, Ill. 60515.

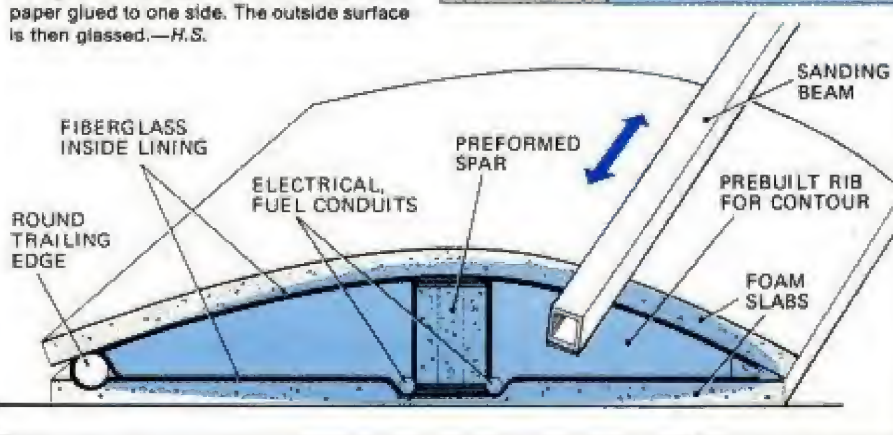


A WHOLE NEW WAY OF BUILDING AIRPLANES

In ultralight wing construction process pioneered by designer Burt Rutan, a foam block is contoured (above) to exact airfoil shape by "sculpting" with an electrically heated test wire, which is passed around templates at each end of the block. Templates are marked with gradations ("talking numbers") so the wire moves evenly at both ends. Alignment of templates to avoid twist—or induce desired amount—is critical.

At right, a coat of resin is applied to airfoil-shaped foam; when tacky, fiberglass is smoothed on. Then, a stiff paintbrush is used to stipple the surface of the glass; this brings the resin up through the open weave, allows glass to be "wet out" with a minimum amount of resin. Brushing action tends to unravel glass edges; stippling avoids this. Excess resin is then squeegeed out of the glass to cut weight. To give the completed layup a smooth finish, a layer of heavy Dacron cloth ("peel ply") is squeegeed on last, pulled away when the resin has cured, leaving a surface ready for painting.

In an alternate technique (below) developed for Poillwagon ultralight, the wing is built from inside out. A foam slab is laid down and grooves cut to receive electrical and fuel lines, plus prebuilt spar and round trailing edge. The inner surface is covered with fiberglass. A second foam slab is lined with glass and resin, inverted and positioned as the top wing section (weighted down) while still wet. Final contour is achieved by embedding preformed fiberglass ribs in each end of wing, then sanding foam to conform to them with a long aluminum box beam which has sandpaper glued to one side. The outside surface is then glassed.—H.S.



FIRSTHAND REPORT

by Gary Witzenburg
DETROIT AUTO EDITOR



Driving the Peugeot 505

Peugeot is now Europe's largest carbuilder and the sixth largest company of any kind outside the United States, producing some 2.25 million passenger cars annually. (Peugeot acquired Citroen in 1976 and Chrysler France in 1978.) Peugeot itself is the world's second oldest automaker (established 1889), and today its model range stretches

from tiny, front-drive econoboxes like the 104, to large, luxury tourers like the 604.

The first number in these model names indicates the size and price range, the middle one (zero) means nothing, and the final digit is the numerical order of each car's design. Thus the 104 is Peugeot's fourth-generation inexpensive, tiny car,



On the road, the 505's four-wheel independent suspension gives a smooth, comfortable ride. It eats up the worst bumps easily and doesn't transmit them to your body.



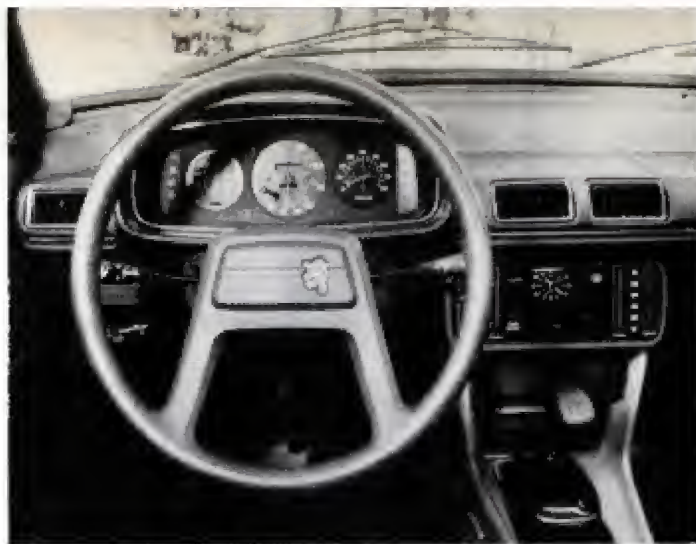
Perfect 50/50 front/rear weight distribution provides crisp and responsive handling.

Styling refinements were the work of legendary designer Sergio Pininfarina. The odd-looking humpback slope of the trunk, trademark of the 504, now cuts a sharper, cleaner line. The only styling fault is the headlight bezel, but that will be revamped soon.





Large glass area and slim pillars give good visibility. Rear suspension is independent, with coil springs, rear trailing arms.



Two-spoke steering wheel gives an excellent view of all gauges. Large vents, excellent climate control system provide comfort.

and the 604 is the fourth try at a big, expensive sedan. Second from the top in Peugeot's pecking order for the past decade has been the somewhat unexciting but rock-solid 504, the mainstay of the company's U.S. importations. It's available in four-door sedan and roomy five-door wagon, with a choice of four-cylinder gasoline or diesel power.

Now comes the fifth-generation "5-series" Peugeot, the all-new 505. And I'm here to tell you, folks, when these Frenchmen replace an old car with a new one, they don't fool around! While the basic, under-the-body design remains similar, the 505's overall effect is about as much like the 504's as a 747 resembles a DC-3.

The 504's exterior styling, while short of downright ugly, was plain as an old shoe; the 505's look (except for the ungainly headlamp bezels, which we'll get to later), stroked by Italian master-designer Sergio Pininfarina, is about as balanced, handsome and classy as any four-door sedan has a right to be.

The 504's aged interior seemed decorated in Early Nash Rambler; the 505's tasteful cockpit stands right up there with the best GT sedans in both style and function. But beyond the mere cosmetics, the 505 seems only about 20 hp short of being a French BMW in terms of responsiveness and surefooted handling.

The European-version 505, with huge, clear headlamp lenses filling the odd-shaped spaces between its grille and fender edges, is arguably the best-looking French sedan in memory, maybe ever. Unfortunately, the U.S.-spec solution of four round, sealed beams in big, aluminum-colored plastic bezels, seems to spoil the car's whole frontal effect. It's a beauty from any other angle, though, and they're still working on better ideas for the headlamp area.

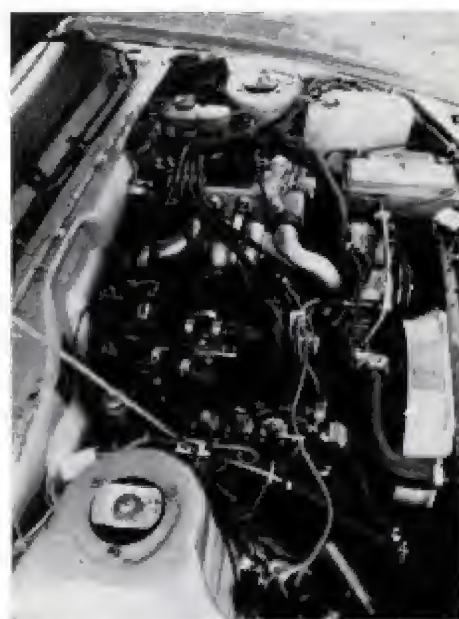
First-class interior

The interior scene is dominated by a large, comfortably padded steering wheel with the currently fashionable downward spokes. This gives an unobstructed view of the nice, orange-lit instrumentation deeply recessed behind an anti-glare clear plastic lens, but we still prefer horizontal spokes as thumb-hooks for serious driving.

Stalk controls for headlamps, wipers and cruise control are nicely labeled and easy to operate, and a pleasant surprise is the left-side turn signal location and right-side ignition switch—a change from previous Peugeot practice, which was as annoying as it was confusing.

Door bins and a wide, flat sectioned dashtop provide oddments storage (smaller sections would keep things from sliding around when cornering, though), and the glovebox is as roomy as a shopping bag.

Fresh, airconditioned or heated air comes as desired from large outlets in the dash and console, and even from under the front seats to warm your rear passengers' feet. Well-marked vertical sliding levers effectively control all this circulation from a central module, though the far-right mode selector is a long reach for the driver. Power window and sunroof controls reside in easy



The two-liter gasoline engine produces 96 hp; the 2.3-liter diesel yields 71 hp.



Bucket seats provide good lateral support, are adjustable fore and aft, and for rake.

reach on the console, along with a handy coin bin for toll-paying commuters.

Best of all are the seats, a new design with molded foam instead of the

[\(Please turn to page 126\)](#)

SPECIFICATIONS—PEUGEOT 505

Length: 186.6 in.
Width: 68.3 in.
Height: 57.1 in.
Wheelbase: 107.9 in.
Curb weight: 3020 lbs. (gas); 3170 lbs. (diesel).
Engines: 2.0-liter gasoline, 2.3-liter diesel.
Transmissions: Five-speed manual (gas); four-speed manual (diesel). Automatic is optional with both engines.
Fuel capacity: 18.5 gal.
Trunk volume: 13.8 cu. ft.

PYROTECHNICS TO SAVE YOUR LIFE

Choose 'fireworks' that meet new Coast Guard standards and you'll have a head start on boat safety.

by Jim Martenhoff

Celebrate the Fourth of July afloat. Carry visual distress signals on your boat. It can be a new kind of Independence Day—independence from undue concern and a head start in safety for you, your passengers and crew.

There are sound reasons:

■ Uncle Sam is going to demand that many pleasure boats carry visual distress signals, starting Jan. 1, 1981. Signals are not presently required on recreational craft, but since it is never too soon to be safe, why not start now?

■ The government is laying down the law to manufacturers. Distress signals will work better than they ever have before, for they must meet tough specifications.

They haven't always worked—a fact discovered by countless amateur mariners over the years. If they did, often it was with laughable effect—if you were in a position to appreciate humor. Almost 20 years ago, just before a Miami-Nassau Ocean Powerboat Race, an enterprising manufacturer distributed free pen-size, red, aerial-flare pistols with small-caliber cartridges. The ocean racers found the peanut-shells amusing.

Nearly all were fired into the Miami River from the cocktail deck of the race headquarters hotel. Offshore veterans of a chancy game didn't trust the undersize gadgetry with cutesy pyrotechnics.

Not to knock legitimate manufacturers, but there also have been gadget builders primarily seeking profit by taking advantage of boatowners hunting bargains. That's why you could find cheapie flares—more properly called fusees—packed with paper matches. They were apt to get soggy in storage and wouldn't light in a mild breeze. There were also flare pistols with firing pin problems, meteor flares that burned out in the blink of an eye, and other safety shortfalls.

Even relatively good pyrotechnics had their disadvantages. A hand-held red flare (apart from the fact that it could hardly be seen in bright sun-

PM photos: Jerry Imbert/Cypress Gardens



Required for coastal waters and worthwhile everywhere, visual aids at right are SOS flasher, flare pistol.

Choice of aids (left):

1. Flare pistol.
2. SOS light.
3. Dye.
4. Parachute flares.
5. Signal flag.
6. SOS flashlight.
7. Smoke and rocket flares.
8. Flare kit.
9. Signal mirror.

Dye marker and mirror are options.





For daytime distress signalling (top), Coast Guard will require approved signal smoke or emergency flag. As of 1981, flag will have a black circle and square on a bright red-orange background.

In distress, a boatman can use a light (above) that automatically flashes SOS. Hand-held flares are not yet approved by the Coast Guard because of fire hazard, but may eventually be allowed.

BOULDER, CO. 80501

light) might also drip hot slag. (Slag: lava-hot dross from the burning flare.) Slag could add fire inside the boat to your other survival woes. Unhappily, many a skipper never read the directions and trained himself to hold the flare overside at an angle, and either started a blaze aboard or burned his hand.

Hence the action by the U.S. Coast Guard. Starting New Year's Day, many (but not all) U.S. skippers will have to tote distress signals that have been approved by the Coast Guard. That means marine pop-and-fizzle gadgets will vanish from the market. Let's look at some regulatory details, immensely condensed from the massive bureaucratese:

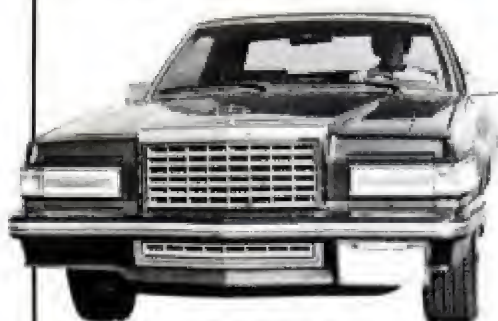
1. The new regulations apply to all boats 16 feet

(Please turn to page 116)

"I've always believed Thunderbirds are pretty," beams a Mississippi housewife. That simple statement sums up the main reason Americans have been buying Ford's personal luxury car for a quarter century.

The Thunderbird celebrates its 25th Bird-day—its silver anniversary—this year. And while the 1980 model looks not at all like the first two-seater of 1955, the nameplate's basic appeal remains the same.

Nearly half the 1000 Thunderbird owners we surveyed listed *styling* as their primary reason for buying. And 45.1 percent



Despite less weight and size, new T-Bird keeps its traditional ride and roominess.

also noted *styling* as the 1980 car's best-liked feature.

The T-Bird appeal, though, does involve more than its pretty face. Owners

PM OWNERS REPORT: FORD THUNDERBIRD

listed the following among their reasons for purchase.

"I preferred the smaller size and better fuel economy of the 1980 to the 1977 Thunderbird I had previously," notes a Texas electrical engineer, who adds that he's now getting 23-plus mpg, thanks to the overdrive automatic transmission.

A retired Alabamian: "I sold Fords for 25 years and have had a new Thunderbird every season since 1955. In my opinion, it's the only car on the road."

"Price sold me," comments a Wisconsin retiree. "Here's one 1980 car that's still selling for nearly the same as the 1979 model."

An Ohio employee relations manager: "I've always liked the luxury of T-Birds. This car is quiet and plush—first-rate—

and I can appreciate the little extra touches in the Town Landau like the chimes, digital instruments and automatic seats and windows."

But the majority of our respondents jotted down things like: "... nice, clean lines," "... liked the way it looks," and "... I enjoy driving a handsome car," when we asked their reasons for purchase.

We found that we had uncapped a minor twister when we asked about fuel mileage. Of the owners queried, 12.5 percent told us they'd been led to believe they'd get better.

"I traded in a 1977 Bird that got 18 mpg and was an excellent car. Naturally, I expected better mileage from this smaller, lighter 1980 model. You can imagine my disappointment at averaging 14.2 mpg overall," complained a Texas teacher.

A self-employed Oregonian echoed: "I



Digital speedo and chimes please owners, but the standard bucket seats bother some.

BY MICHAEL LAMM WEST COAST EDITOR

Crisp styling and ride draw raves, but mileage and headroom could be improved



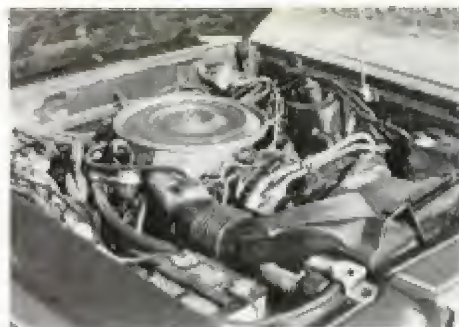
Give us more front headroom, suggest taller drivers.

The larger 302 yields better mpg than 255 V8 in highway driving.

Headlight covers tend to stick or break, some owners tell us.

Thunderbird shares Fairmont unitized body/chassis, suspension, steering, and inner body panels.

PM Photos: Robert J. Lamm



Larger 302 V8 delivers slightly better mpg than the 255, thanks to o.d. automatic.

feel the TV and magazine claims of 18 to 26 mpg constitute false advertising. I'm getting 11 mpg in town and 20 on the open road. A neighbor who also owns a 1980 Thunderbird says he's getting 8 to 9 mpg. So I guess I'm really lucky!"

In fairness, the Environmental Protection Agency's rating is 17 mpg overall. Note that our data panel shows T-Bird owners reporting an average of 15.75 mpg in town and 21.70 on the highway with, surprisingly, the larger 302 V8 topping the 255 in long-distance mileage. But perhaps this isn't so surprising when you consider that the 302 (five-liter) engine is teamed with the overdrive automatic as standard equipment.

Furthermore, here's a New York payroll clerk's experience: "My dealer had told me to expect about 25 mpg on the high-

way. I drove down to Florida and got 23.7 mpg, but on the trip back, I found that by using a different brand of gasoline, I hit 25.3 mpg, and this even included hilly turnpikes and two accidents that slowed traffic."

And the following are typical responses to our request that owners list the 1980 Thunderbird's best- and least-liked features.

A New York housewife: "My 1980 Bird handles much better than my previous models; and it also has more trunk space. On the other hand, I do not like the horn button on the end of the directional stalk."

An Ohio dry cleaner: "Exceptional ease of handling, especially on snowy and icy roads. But there's too much plastic and not enough gas mileage."

A Texas electronics tester: "The special Michelin TR tire option and suspension package make for fantastic handling! The trunk is a great size now that the spare is smaller. But I'm 6-2, and even with the seat all the way back, I hit my knee on the transmission shifter handle. Something's got to be done about that shifter!"

An Oregon millworker: "We've got the Recaro bucket seats and like them very much. I've heard other owners complain about the standard seats and the fact that they're uncomfortable and don't have

(Please turn to page 122)

The Bird's 25th Bird-Day

Twenty-five years ago, Thunderbird launched the "personal-car" concept. That 1955 two-seater captured the hearts of the car buffs of the '50s—and it continues to do so. No fewer than five replicar makers offer two-seater facsimiles today.

The 1980 Thunderbird comes closest of all factory-built models to the original in size and weight. All others, from 1958 through 1979, were heavier and larger.

Ford has pared the '80 T-Bird's weight by 800 pounds and trimmed 16.8 inches from the '79's length. Thunderbirds now share the Fairmont's basic unitized body/chassis, suspension, steering, brakes, and some inner panels.

The 1980 model sells in its base form for about \$6300 today. Standard engine and tranny is the 255-cu.-in. (4.2-liter) V8 with the non-overdrive SelectShift automatic. The five-liter 302 is optional and comes with Ford's new overdrive automatic.

For roughly \$10,000, the Thunderbird Town Landau offers a full array of standard extras, including air, power windows and seat, locks, tilt wheel, AM/FM stereo, headlamp delay, digital instruments, handling package, Michelin TR radials, aluminum wheels and much more.

There's also a Silver Anniversary Edition offered for \$1600 more than the Town Landau. This model repeats all the landau's equipment and cloaks the entire package in a silver interior and exterior appointments and trim.

A NATIONWIDE SURVEY BASED ON 933,860 OWNER-DRIVEN MILES

Town Landau model comes fully equipped, costs about \$10,000.



Mini-spare helps increase good-size trunk.



Thunderbird's trunk boasts plenty of floor area but not much depth. A few owners criticized taillamp treatment as not fitting in with rest of Bird's styling. Yet car does uphold identity established in mid-1960s.



Landau and Silver Anniversary models get Michelin TR radials and aluminum wheels as standard equipment.

Bumper won't accept trailer hitch, which must attach to body.

2 HANDY OUTDOOR PROJECTS YOU

Easy-to-build bike repair stand

Build this lightweight bike repair stand for about \$5. It disassembles for storage or transport and adjusts to suit different size bikes. Draw guide marks to speed positioning of the support brackets (B and E).

The bottom support assembly is made of two parts (A) joined in a T-shape, to which you attach the bottom V-notched bracket (E). Bore a hole on both ends of the T-bar so you can put the aluminum tube (G) on either side of the bike, out of your way. Taper the upper support bracket (B) (see drawing) so it fits bikes with little distance between top and bottom bars. The V-cut in bracket B is over the center of the bottom T-support.—*Stephen Peterson*



The top support bracket of the bike stand holds the 10-speed touring bike by its top bar. The stand's top support bracket can hold a woman's bike by its handlebar stem.

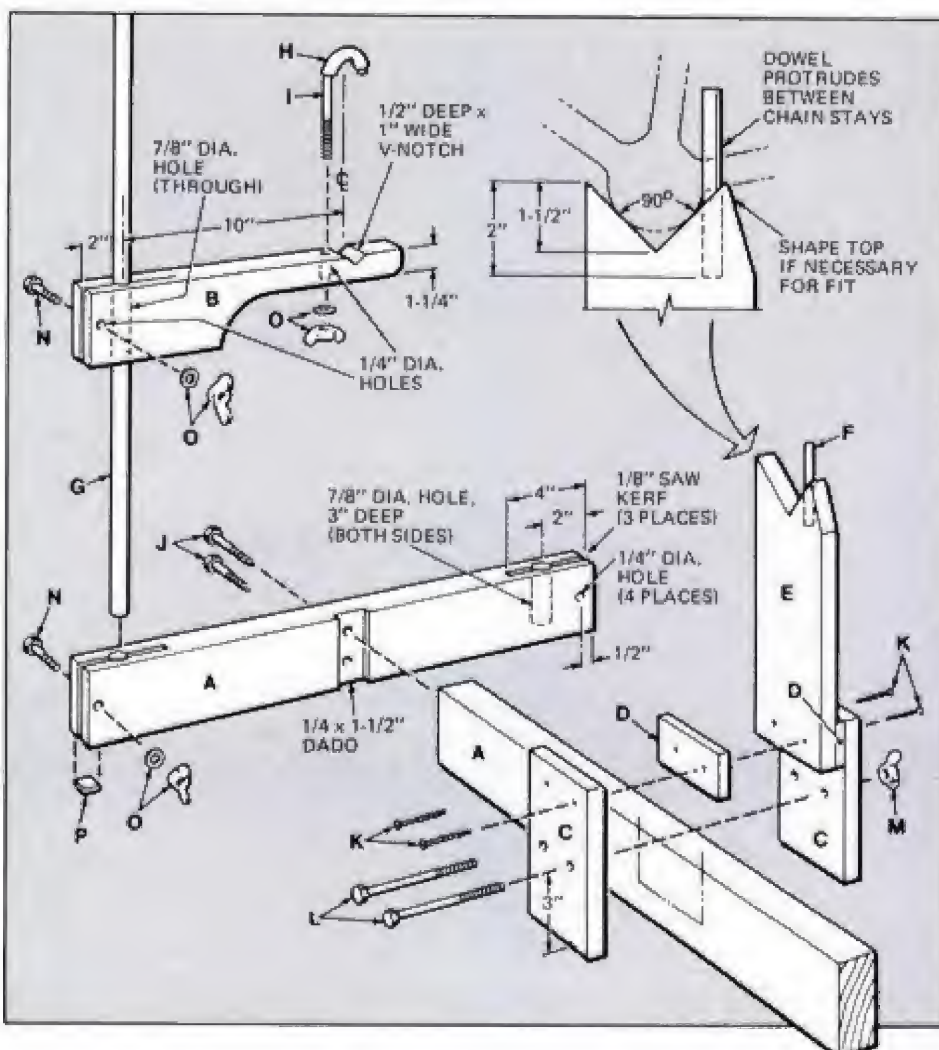
MATERIALS LIST—BIKE STAND

Key	No.	Size and description (use)
A	2	1½ x 3½ x 24" fir
B	1	1½ x 3½ x 14" fir (upper support bracket)
C	2	¾ x 3½ x 7" pine
D	2	¾ x 2 x 3½" plywood (shims)
E	1	¾ x 3½ x 12" pine (lower support bracket)
F	1	¾" dia. x 4" dowel
G	1	¾"-o.d. x 4-ft. aluminum tubing
H	1	short piece rubber or plastic tubing
I	1	¼-20, 1½"-wide x 3" U-bolt (cut off one leg)
J	2	¼ x 4" lagscrew
K	4	2" No. 10 fl. screw
L	2	¾ x 4½" bolt
M	2	¾" wingnut
N	2	¼-20 x 2" bolt
O	3	¾"-i.d. washer, ¼-20 wingnut
P	3	½ x ¾ x ¾" self-adhesive furniture bumper

Misc.: White glue, primer and exterior paint.



Bottom support (E) has a dowel stop (F).



CAN MAKE IN A JIFFY

Big-capacity barbecue skewers

These simple-to-make barbecue skewers with handles of 1-in. walnut stock are such appealing gift items that you might cut extras while making your own.

First cut the walnut handle and protective cap. Shape both using a rasp or disc or belt sander. Bore a $\frac{3}{16}$ -in.-dia. hole in the handle for the leather hanger and chamfer both sides with a 45° countersink. Make a similar chamfered hole near one end of the cap for the lashing cord. Bore a $1\frac{1}{2}$ -in.-deep hole in the handle for the skewer rod and a hole in the cap for the skewer point.

You can turn the ferrule seat on a lathe or fashion it with hand tools. If working by hand, first establish the ferrule boundaries with a very shallow saw cut. Rough-cut the seat with a knife and finish smoothing it with a rasp or sandpaper. Rub the handle and cap with boiled linseed oil.

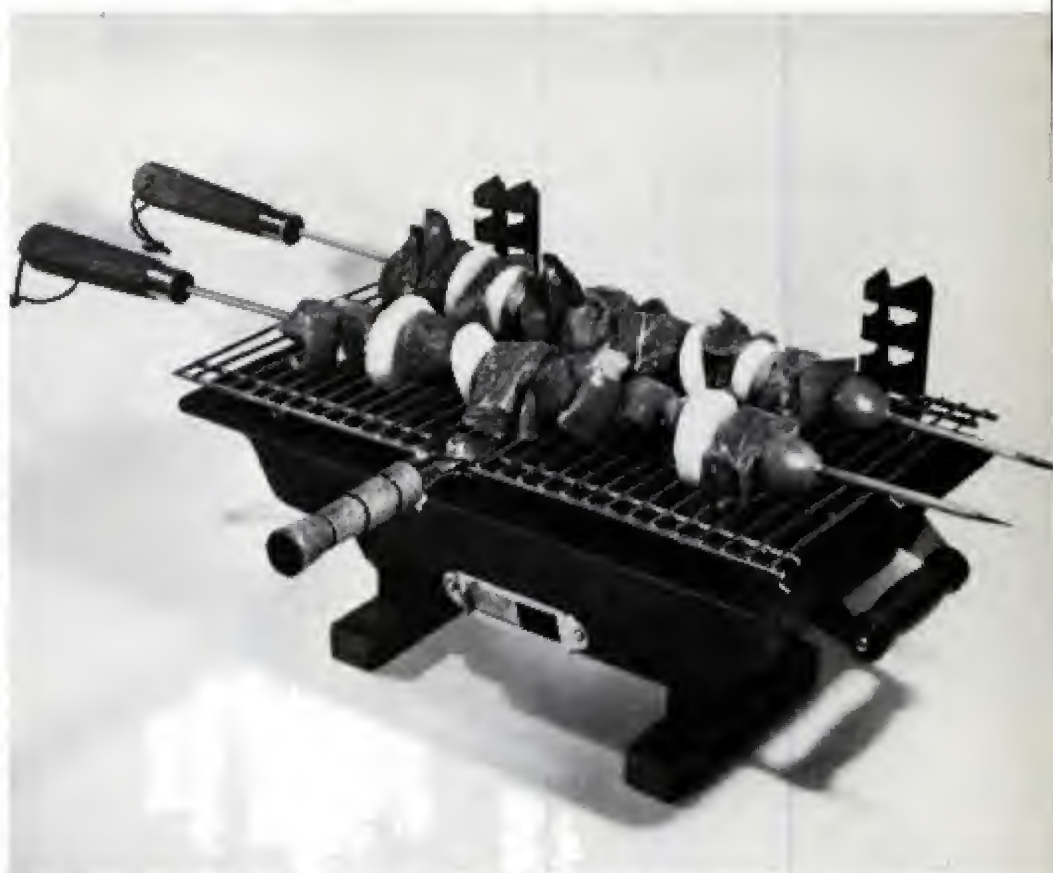
You may want to thin the wall of the copper pipe to make a more attractive ferrule. To do this, chuck a length of pipe in a three-jaw chuck, support the outer end with a live center in the tailstock of a lathe and turn the pipe until the wall is about $\frac{1}{32}$ -in. thick. Then cut off a ferrule. Spray the ferrule with Krylon Crystal Clear Acrylic so it won't tarnish. Force the ferrule onto the handle. Bore a shank hole in the ferrule and a pilot hole through the wood; turn in the attachment screw.

Cut the square stainless-steel rod to size and shape the point on a lathe or grinder. Force the blunt end of the rod into the predrilled handle. You can do this by first securing the rod in a drill press. Attach the leather thong to the handle and the cord to the cap.—*John H. Vivian and John Bostonian Jr.*

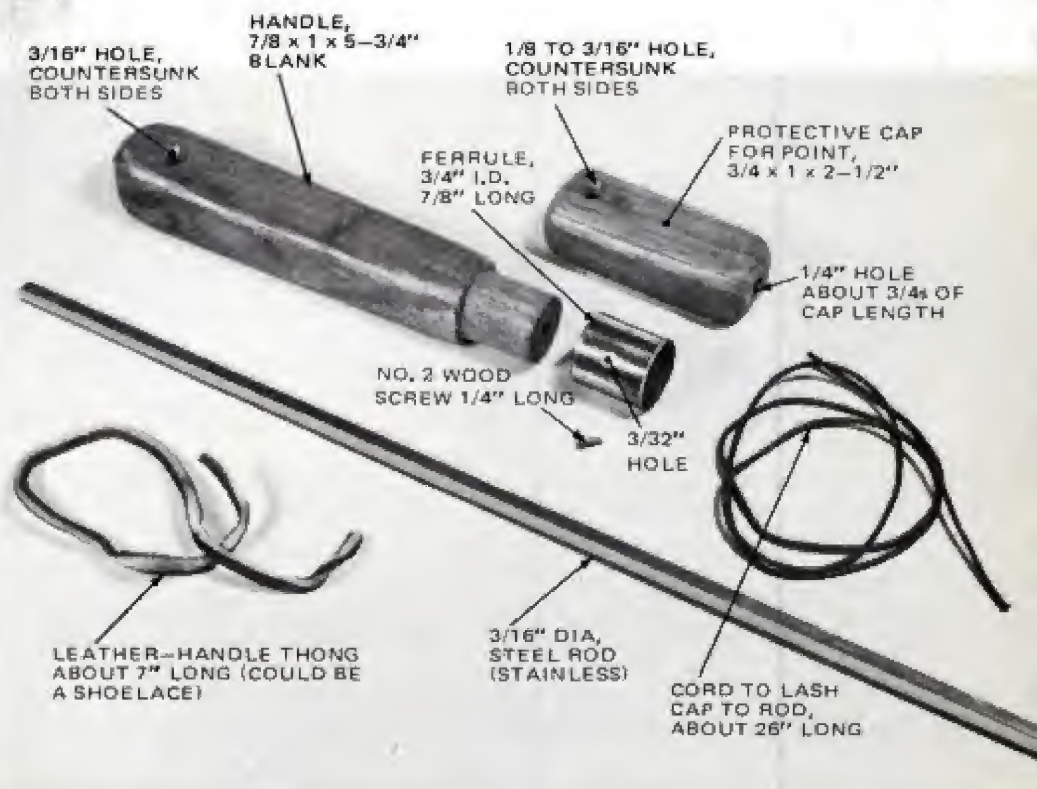
MATERIALS LIST—SKEWER

Pcs.	Size and description (use)
1	$\frac{3}{4} \times 1 \times 5\frac{1}{2}$ " walnut (handle)
1	$\frac{3}{4} \times 1 \times 2\frac{1}{2}$ " walnut (skewer cap)
1	$\frac{3}{4}$ " I.D. $\times \frac{3}{4}$ " copper pipe (ferrule)
1	$\frac{1}{4}$ " No. 2 rh wood screw (secure ferrule)
1	$\frac{3}{16} \times 24$ " stainless-steel square rod (skewer)
1	26" cord (lash cap to skewer)
1	7" leather thong (skewer handle)

Misc.: White glue; Krylon Crystal Clear Acrylic spray for copper (optional); boiled linseed oil



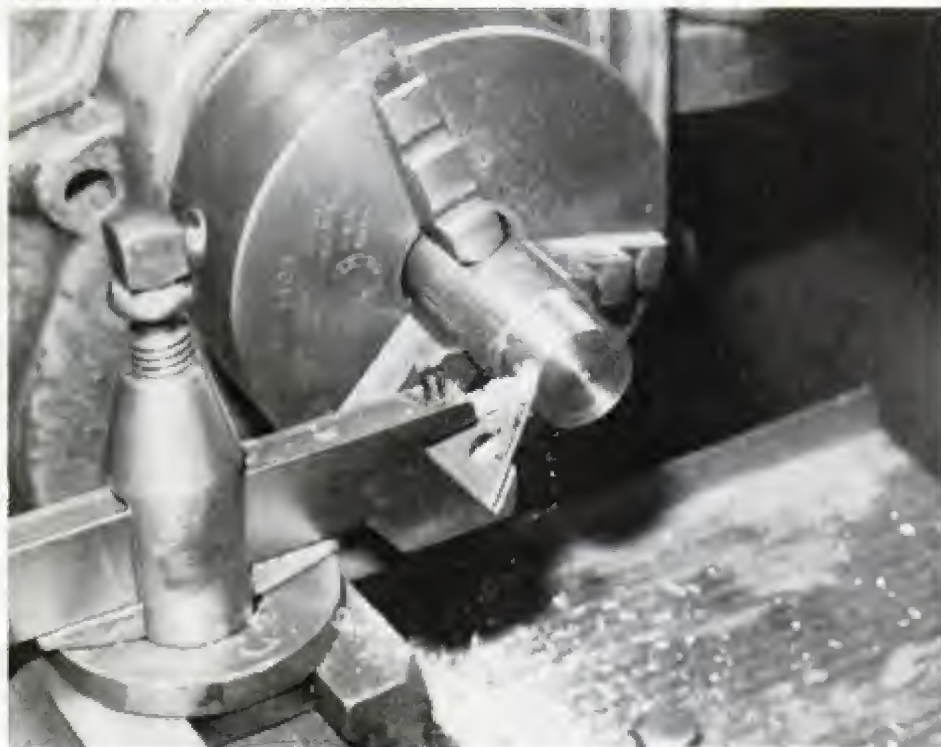
For a simple, yet novel outdoor meal, load these barbecue skewers with kebab makings and lay them directly on a grill. The stainless steel skewers will remain rust-free.



Skewer parts are cut, shaped, finished and ready for assembly. Note that a cap for the skewer point is made for use during storage. Although it may fit snugly at first, the cap will loosen in time. For best results, attach a lashing cord to it.

WEEKEND WORKSHOP: 4 great projects

Lathe tool-bit holder



This easy-to-make tool-bit holder allows you to use three different cutting surfaces on one lathe tool bit. The holder can also be used on a standard lathe compound rest.



Triangular rake insert is held securely in tool-bit holder by a setscrew. Release the setscrew to change the cutting edge.



The rake or angle ground on the triangular insert is only one of a variety of quick-change cutting edges that are possible.

The advantages of having three different cutting surfaces in one lathe tool bit are many, especially if such a bit can be used in a standard lathe compound rest. This was easily accomplished by using a triangular, negative-rake carbide insert (Carboloy TNMG-542E) along with the special tool-bit holder shown in the drawing below. The combination permits a variety of lathe-turning operations from general turning to cutting threads, along with fast changeovers.

Lay a standard, straight lathe tool-bit holder, with bit in place, over the uncut steel bar stock to serve as a pattern. This determines the overall size and tool-bit cutting-edge position. Having marked the overall tool size, lay the triangular insert in place over the marked bar stock and scribe a line where the insert portion will fit. The shank dimension remains the same as that of a standard lathe tool-bit holder, $\frac{3}{8} \times \frac{13}{16}$ in.

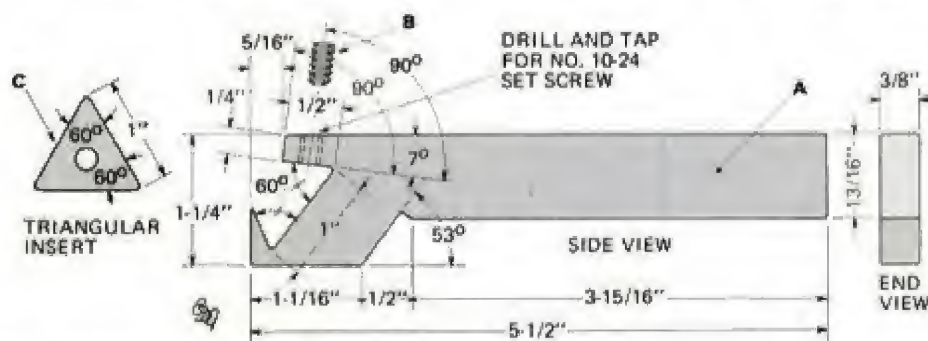
Next, cut out the tool and triangular hole in the tool-bit head using a hacksaw. Due to its configuration and position in the lathe tool holder, the triangular tool bit has proper rake and end clearances. These can, of course, be adjusted as desired when cutting out for the insert and can be altered further by tool-bit grinding if desired.

Carefully file, shape and smooth the rough-cut surface of the tool-bit holder for appearance. Use a good, sharp, proper-fitting file to form the final dimensions of the triangular insert hole. Then drill and tap a screw hole in the lip at the upper edge of the toolholder. Install a setscrew to secure the triangular tool-bit insert. Any of several edges can be ground on the inserts, including thread-cutting, rounded spade and rake edges.—Norman E. Johnson

MATERIALS LIST—TOOL-BIT HOLDER

Key	No.	Size and description
A	1	$\frac{3}{8} \times 1\frac{1}{4} \times 5\frac{1}{2}$ " cold-rolled steel
B	1	No. 10-24 setscrew with hexagonal socket-type head and cup point
C	1	cemented carbide insert (Carboloy TNMG-542E)*

*Inserts are made by the General Electric Co., Carboloy Systems Dept., Box 237, G.P.O., Detroit, Mich. Write for the address of the nearest distributor and for prices, which vary from \$5 to \$11 an insert, depending on number you purchase.



for your shop

Grid-ruling tool

Anyone who regularly engages in a variety of new and different projects will appreciate this quick and easy grid-ruling tool. It can be used on any flat surface. If a drawing board is used, the end pieces are hooked over the top edge of the board. If used on other flat surfaces such as a table or workbench, turn the scale over so that the rulers lie flat on the working surface.

In either case, tack down the unit and use a fine-pointed pencil or ball-point pen to draw the vertical lines. Then remove the pins or tacks holding down the scale and rotate the paper 90° so that the drawn lines are horizontal.

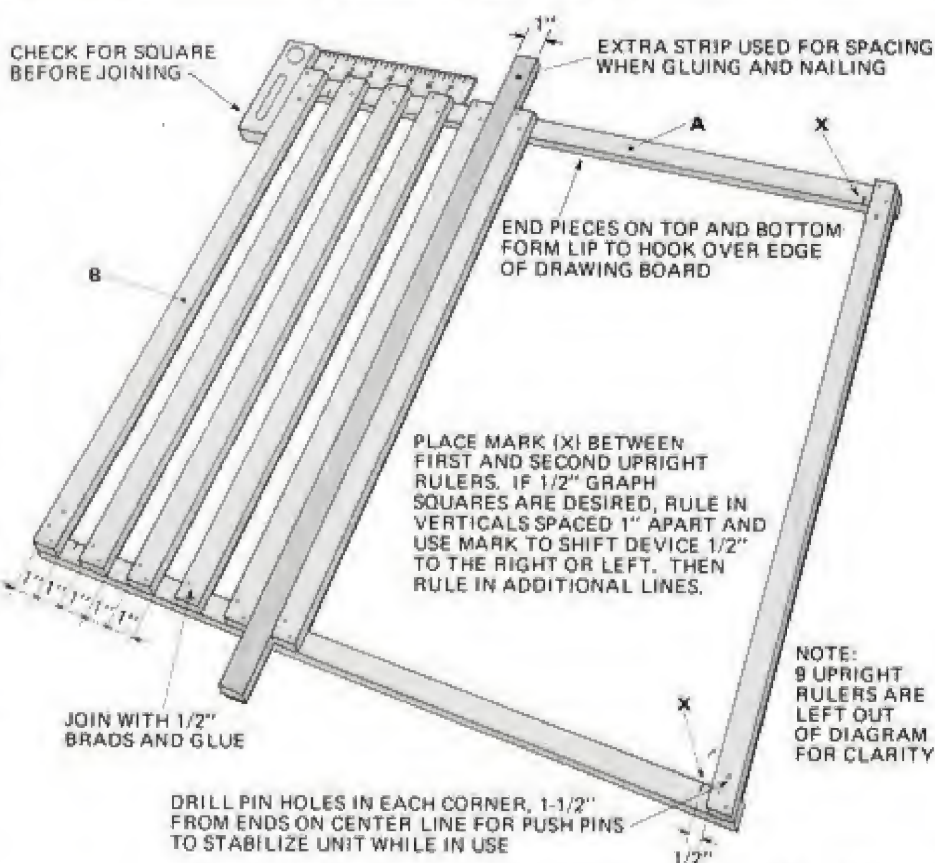
Place an edge of one piece (B) so that it aligns with one edge at either end of the paper; fasten and complete the grid. Use rolled drawing or tracing paper or, when extra-large paper is needed, the back of leftover wallpaper or brown wrapping paper. For patterns that will be reused, use cardboard salvaged from department-store suit boxes.

Rip warp-free hardwood strips, using a table or radial-arm saw, to dimensions given. Sand smooth using a sanding block. Good lumber-core plywood may be substituted if hardwood isn't available. A plywood-cutting blade gives smoothest results.

Next, lay the top and bottom pieces (A) on a flat working surface. Choose one ruler (B) for the starter and lay it on top. Attach the ends with a dab of white glue and two 3/8-in.-long brads per joint. Use a square to assure perfect 90° angles. Use the extra strip to space the remaining rulers, fastening each with glue and brads until all 16 are in place. Allow glue to dry.

Ink or paint a mark (X) between the last two rulers. This will enable you to use the scale to lay out 1/2-in. grids when needed. Drill four pin-size holes with a fine wire drill (one in each corner) for push pins or thumbtacks.—Robert Bessmer

This simple tool, used on a drafting board or a table, allows you to quickly rule grids with 1/2-in. or 1-in. squares. It is especially useful when you are preparing paper for the enlargement of workshop plans to full-size patterns.



MATERIALS LIST—RULING TOOL

Key	No.	Size and description
A	2	1/4 x 1 x 31" hardwood
B	16	1/4 x 1 x 30" hardwood

Misc.: 1/4 x 1 x 36" spacing strip; 3/8" brads and glue.

Drill-press accessory board



Racks for accessories can be swung to within an arm's reach of drill press station.

A good criterion for judging shop storage is that it should be there when you need it, but not be in your way when you don't. This hinged accessory board swings to within easy reach when you're using



When not in use, these compact racks store out of your way against the shop wall.

the drill press, but lies flat against the wall at other times. Besides being convenient, it keeps cutters and bits without risking damage to their cutting edges.

The middle three shelves are built with bottom stops (D) which allow enough depth to keep bits from toppling. Unlike a blind-hole approach, they also let you vacuum out chips and dust without having to remove the accessories from the holders. The top shelf has short pegs for keeping items such as hole saws. The bottom shelf is sized larger than the others for small racks of twist drills, loose gauges and the like. All dimensions can, of course, be changed to suit your collection of accessories.

Building the accessory board

First cut the plywood back panel (A) and lay out the dadoes to receive the shelves. Cut the dadoes with a router or dado head on a table saw. Next, cut the shelves to size. Bore all holes for pegs and tool shanks before continuing. Note: Bore holes for shanks about $\frac{1}{16}$ -in. oversize.

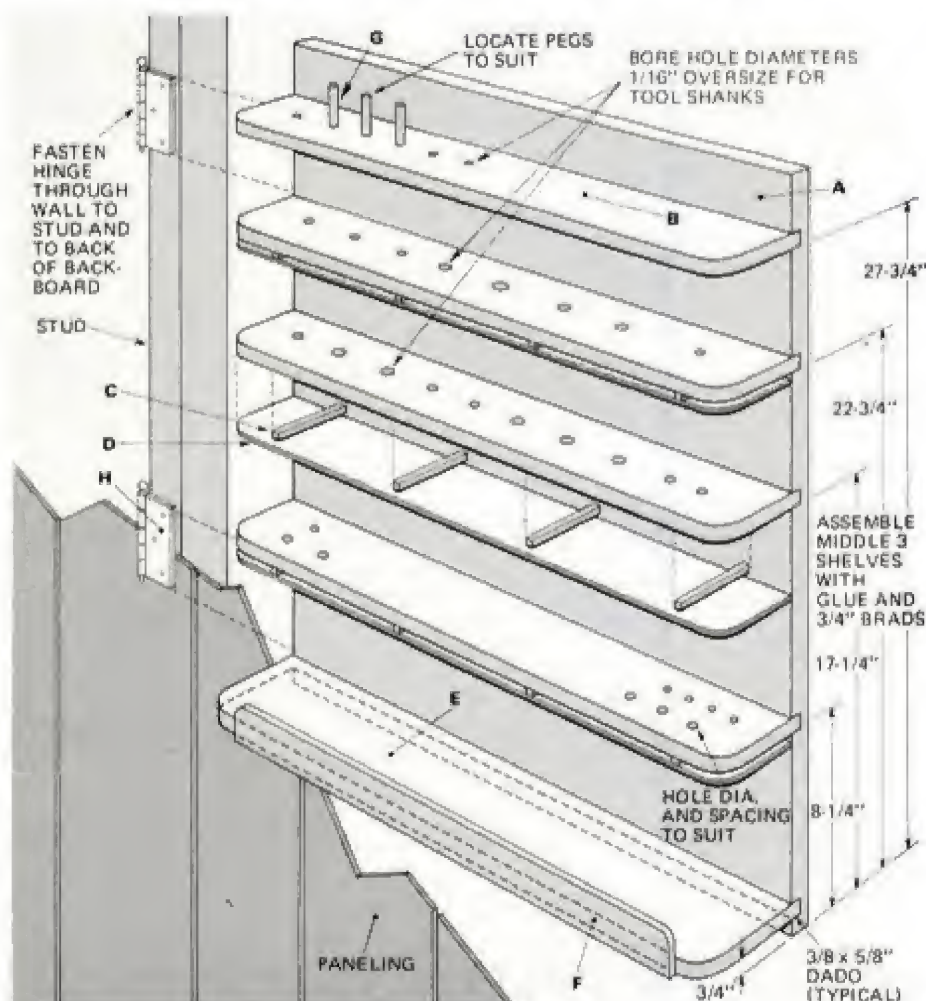
Cut the rest of the parts and pre-assemble each shelf before joining it to the back panel. Use $\frac{3}{8}$ -in. brads and glue to fasten the bottom stops (D) and spacers (C) to the three center shelves.

Join the shelves to the back next. If the fit in the dadoes is snug, you will only need glue. If it is slightly loose, secure with No. 10 \times $1\frac{1}{4}$ -in. fh screws from the back in addition to the glue. Use at least three screws per shelf. Allow the glue to dry and finish with three coats of polyurethane varnish.

Finally, mount the board through wall paneling to a stud, using standard $3\frac{1}{2}$ in. loose-pin door hinges. They will allow easy removal for any future changes or repairs. If the rack does not stay flat against the wall on its own, use a magnetic catch to keep it out of the way when it's not being used.—C.E. Banister

MATERIALS LIST—BOARD

Key	No.	Size and description (use)
A	1	$\frac{1}{2}$ \times 24 \times 30- $\frac{1}{2}$ " plywood (back)
B	4	$\frac{1}{2}$ \times 3 $\frac{1}{2}$ \times 24" plywood (shelves)
C	12	$\frac{1}{4}$ \times $\frac{1}{4}$ \times 3 $\frac{1}{2}$ " pin (spacers)
D	3	$\frac{1}{2}$ \times 3 $\frac{1}{2}$ \times 24" tempered hardboard (bottom stop)
E	1	$\frac{1}{2}$ \times 5 \times 24" plywood (shelf)
F	1	$\frac{1}{4}$ \times 1 $\frac{1}{2}$ \times 22" plywood (shelf lip)
G	(as reqd.)	$\frac{1}{2}$ "-dia. \times 2" dowel (pegs)
H	2	3 $\frac{1}{2}$ " loose-pin door hinge
Misc.		White glue and $\frac{1}{4}$ " brads



Pocket-calculator stand

Pocket calculators, a fixture on more and more desks, unfortunately have a tendency to "grow legs and walk off." Whether your problem is a borrower who is careless about returning the unit—or worse—this good-looking calculator stand will solve your problems.

Begin by carefully tracing the side (profile) of your calculator. Add $\frac{1}{8}$ in. to the overall length and height and draw a box around the outline. Next, draw in the area for the bottom wedges and back and front panels. Use this diagram as a pattern to cut out sides B and wedges A.

Cut four or five wedge sections and glue and clamp them together. When dry, cut the wedge block to a width equal to that of the calculator, plus $\frac{1}{8}$ in. Cut the dadoes in the side-pieces (B) and glue and clamp them to the wedge block. Measure for and cut the front (C) and back (E). Cut the rabbets in E and test for a sliding fit between the sides. Glue on the front. Note: If you own a bandsaw, assemble the case as a box and cut all the required angles with one pass.

Bore a hole for the lock. Then, with a router or wood chisel, mortise the lock flush with the back. Drill a hole through the back of the lock faceplate for the cable. Also, cut a small groove under the lock faceplate for the cable. Pressure on the bent cable will hold it very securely in place.

To locate the hole which receives the lock bolt, apply a light coat of grease to the tip of the bolt. Insert the sliding back into the case and push the bolt. A small spot of grease will mark the spot to drill. Bore another hole in the back large enough to accept the charger plug.

Bend the free end of the cable into a loop and secure it with a cable clamp. Epoxy or solder the heads of the screws. Cut and drill two pieces of aluminum angle. Each should be attached flush with the top of the case.

Before applying finish to the case, remove the hardware; finish with Danish oil. When dry, replace the metal parts.—*Lane C. Sander*



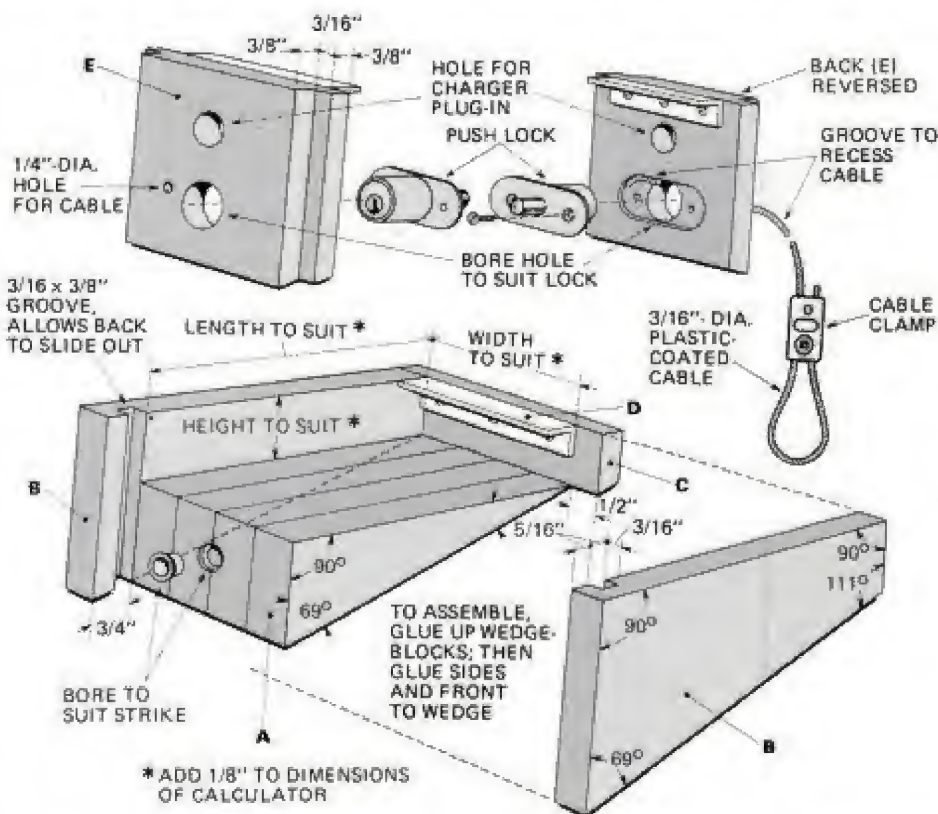
Stand makes calculator easier to read. Its cable can lock to the desk to stop theft.



When stand is unlocked, back of the calculator can be raised for removal. Dimensions may be adjusted to suit any calculator.



Hole in back of stand is aligned with charger jack and permits recharging without removing the calculator from its case.



MATERIALS LIST—STAND

Key	No.	Size and description (use)
A	4 or 5	$\frac{3}{4}$ " pine; short side of wedge is $1\frac{1}{4}$ " long; other dimensions to suit (base)
B	2	$\frac{1}{4}$ " hardwood to suit (side)
C	1	$\frac{1}{2}$ " hardwood to suit (front)
D	2	$\frac{1}{2}$ " x $\frac{1}{2}$ " aluminum angle to suit (retainers)
E	1	$\frac{1}{4}$ " hardwood to suit

Misc.: Push lock, cable clamp, $\frac{3}{16}$ "-dia. plastic-coated cable x length to suit

*Chrome push lock No. 524 (for sliding doors and panels) from Lustre Line Products, Philadelphia, Pa. 19125, was used in prototype. It costs about \$5.50 at hardware stores, building supply outlets and retail locksmith shops.

Try this easy way to create

You can duplicate the beauty of leaded glass in these three projects from the PM workshop.

You can give the distinctive look of stained glass to your workshop projects with very little effort and no special tools. The modern version, using liquid lead squeezed from a bottle, combined with glass stains applied with eyedroppers, eliminates the time-con-

suming, exacting techniques of cutting glass and fusing pieces.

To introduce you to this colorful craft, we've designed three shop projects around stained-glass panels. Following are glass-staining tips.

To stain a pane of glass or a mirror, wash it thoroughly with a vinegar-and-water solution or alcohol. For an acrylic panel, first remove the protective paper and wash the plastic with warm water. Dry with a soft, lint-free cloth. Enlarge the pattern to full size.

1



'stained' glass

by Penelope Angell
and Constance Spates

To stain a mirror or frosted acrylic, transfer the pattern to it with carbon paper. On clear acrylic or glass, place the pattern underneath on a flat surface. Apply liquid lead (black) or liquid pewter (gray) following the pattern lines (see photos, page 99).

Cut the tip of the liquid lead applicator, taking care not to cut too large a hole. You can enlarge it later if necessary.

You'll want different bead sizes on some pieces. For example, the inner lines of the zodiac panel are quite

1 Bogart fans and movie buffs will have a special affection for our Casa (as in *Casablanca*) light box. The art deco cityscape is from marquee on New York's Radio City Music Hall.

2 A dragonfly in brilliant blues presides over this glass-stained mirror. The handsome frame, made from conventional moldings, is an original design from the PM workshop.

3 You can section off living space and still maintain an open feeling with this colorful zodiac panel. To separate areas, suspend the panel over a bookcase or cabinet.

fine (about $\frac{1}{16}$ in. in diameter); the outer lines are thicker.

Squeeze the lead onto scrap paper to check the size (diameter) of the bead that is formed. Once the hole size is correct, you can use the top on subsequent bottles.

Outline the design on the panel with liquid lead, being careful that every bit of the line adheres. Each section must be a tight well so the stains cannot run together. Use a toothpick to dab the bead down where it's not secure. Let the leading dry overnight. Note: Don't expose this water-based material to the outdoors.

Applying the glass stain

Place the outlined piece on a level surface so the stain won't flow beyond its enclosure. Apply the stain with eye droppers, using a different dropper for each color.

To avoid accidents, hold a tissue under the dropper until it is directly over the area to be filled. To achieve the best color, fill each area with stain as far as possible, without letting the stain overflow. Keep the finished piece on a level surface until it is dry.

If any bubbles should appear during the applica-

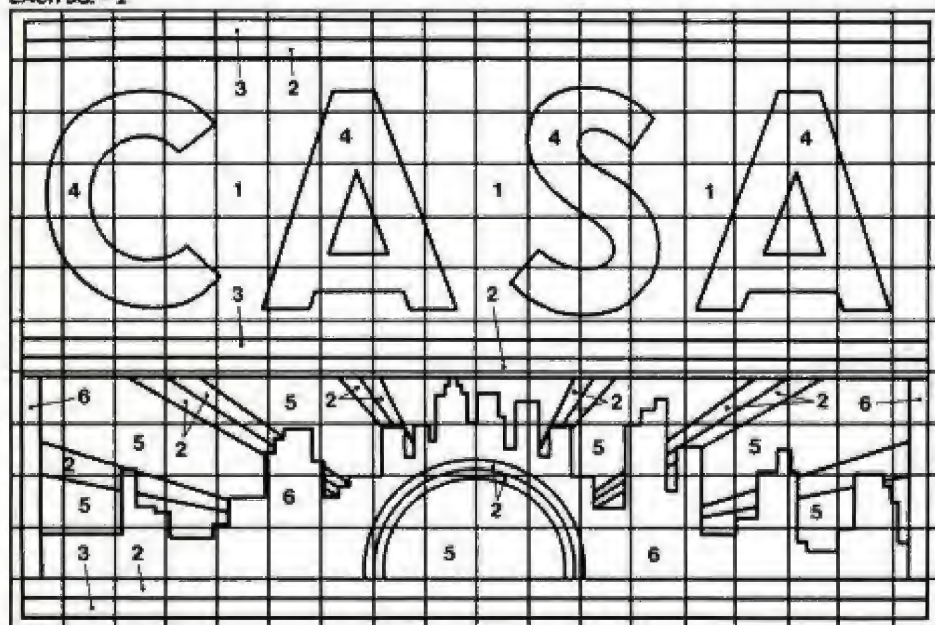
PM photos: Steve Fay
Technical art: Eugene Thompson
Glass-stain designs and execution: Constance Spates
Design and construction: Light box and mirror frame, Harry Wicks; hanging zodiac panel, Rosario Capotosto
Glass-stain materials: Titan Glass Stain, Titan Liquid Lead and Titan Liquid Pewter from Titan Corp., 5629 206th St. S.W., Lynnwood, Wash. 98036. These are available nationally in craft stores and by mail from American Handicrafts, Box 791, Fort Worth, Tex. 76107
Wing chair in zodiac-panel room setting. Available through selected J.C. Penney stores



tion, use the dropper to remove them. If you expel as much air as possible from the dropper before inserting it into the stain bottle, the bubbles will be negligible.

You can correct minor errors or remove drips with cotton swabs. On

EACH SQ. = 2"



glass, let the stain dry; then remove the color with the tip of a knife.

Casa light box

Begin work by cutting frame parts (A,B,C) to size. Cut grooves in these parts to hold backing (G). Also miter

the ends and cut grooves for splines (I). Sand these parts smooth.

Cut hardwood splines and assemble the frame with glue and clamps. Check that it is square; let the glue dry overnight. Next day, secure with well-set 6d finishing nails at joints. Fill holes with wood filler.

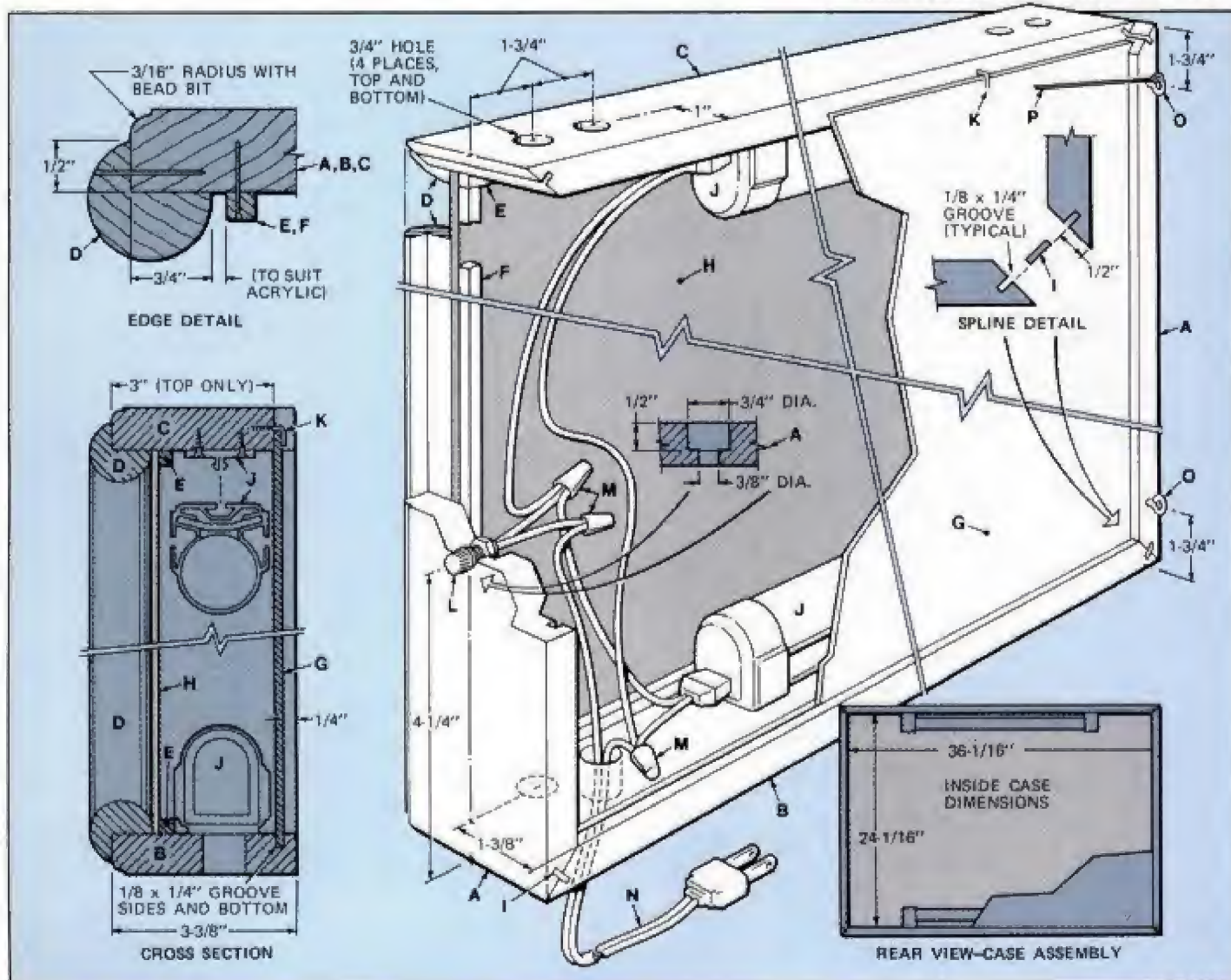
Cut and temporarily install cleats (E,F). These are removed later for

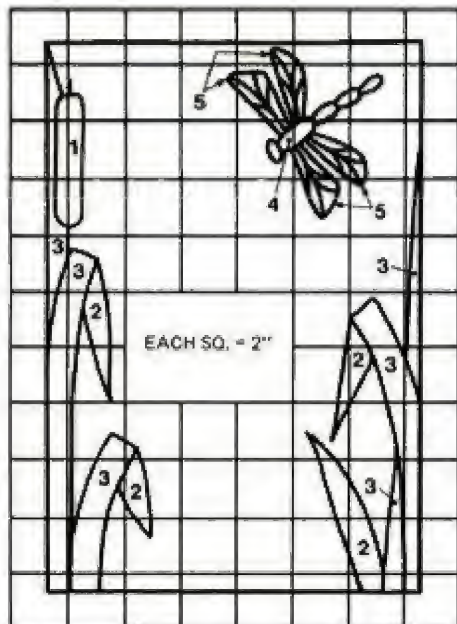
MATERIALS LIST—CASA LIGHT BOX

Key	No.	Size and description (use)
A	2	3/4 x 3 1/2 x 25 1/2" pine (sides)
B	1	3/4 x 3 1/2 x 37 1/2" pine (bottom)
C	1	3/4 x 3 x 37 1/2" pine (top)
D	1	1 1/2"-dia. x 11" round; cut 4 pieces to size (molding)
E	2	1/4 x 1/4 x 36" pine (top, bottom cleats)
F	2	1/4 x 1/4 x 23 1/2" pine (side cleat)
G	1	1/4 x 24 1/2 x 36 1/2" hardboard (back)
H	1	1/4 x 24 x 36" opal/frosted acrylic (glass stain panel)
I	4	1/2 x 1/2 x 4" hardwood (spline)
J	2	24" General Electric Bright Stik (light)
K	2	L-hook (back fastener)
L	1	canopy switch
M	3	solderless connector
N	1	power cord and plug (with Bright Stik)
O	4	medium-size screw eye (for hanging)
P	1	55" picture-hanging wire

Misc.: 1" brads; 3/4" brads; lamp wire; 6d finishing nails; wood filler; white glue; pigmented shellac and glossy white paint. To stain the panel, you'll need eye droppers; full-size pattern; toothpick; four 4-oz. bottles of Titan's Liquid Lead. Also, 2-oz. bottles of Glas Stain in the following colors: Royal Blue, 2 bottles (1); Hot Orange, 1 bottle (2); Red, 1 bottle (3); Lemon, 2 bottles (4); White, 2 bottles (5); and Black, 1 bottle (6).

*Numbers in parenthesis match color code in pattern, left.

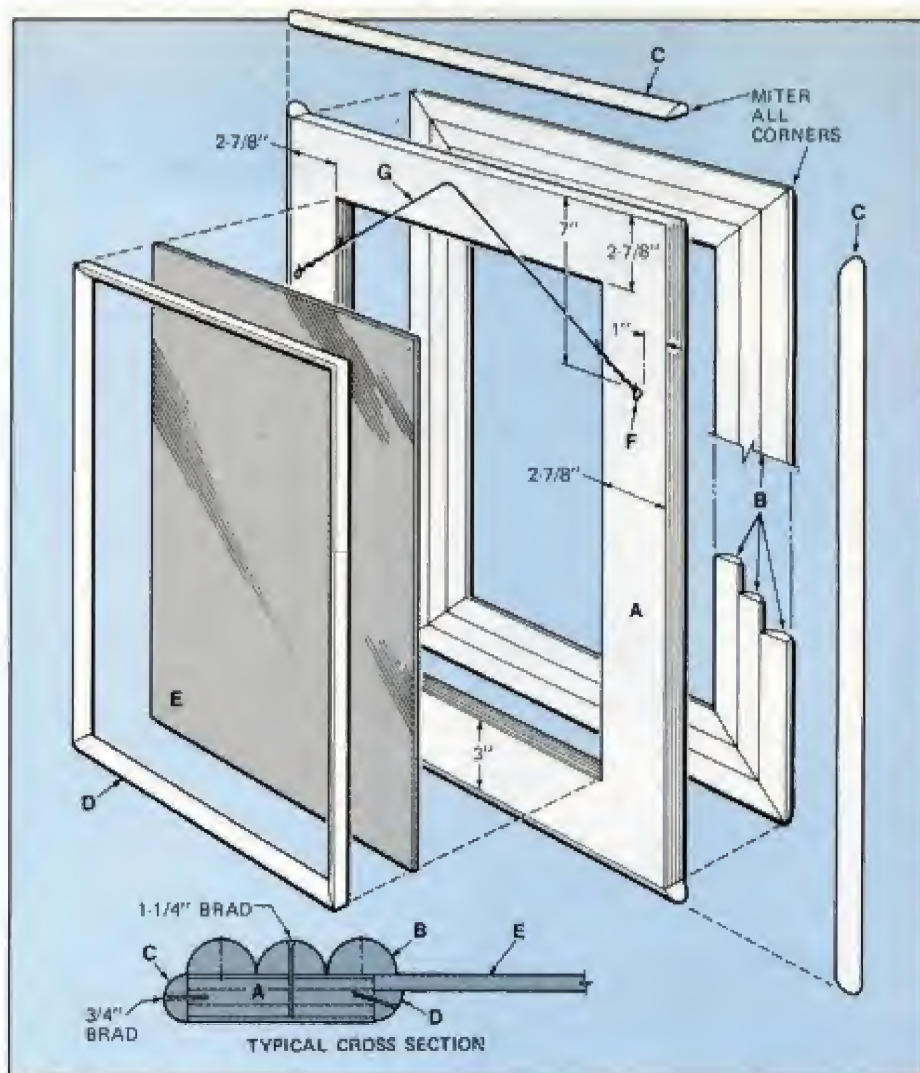




MATERIALS LIST—MIRROR

Key	No.	Size and description (use)
A	1	$\frac{3}{4}$ x 20 x 26" plywood (frame base)
B	1	$\frac{5}{16}$ x $1\frac{1}{4}$ x 24" half round, cut to size (molding)
C	1	$\frac{3}{8}$ x $\frac{3}{4}$ by 8" half round, cut to size (edging)
D	1	$\frac{1}{2}$ x $\frac{1}{2}$ x 8" quarter round, cut to size (back molding)
E	1	$\frac{1}{4}$ x $14\frac{1}{4}$ x 20 $\frac{1}{4}$ " mirror (decorative panel)
F	2	small-size screw eye (for hanging)
G	1	30" picture-hanging wire

Misc.: $\frac{3}{16}$ " brads; $1\frac{1}{4}$ " brads; white glue; wood filler and McCloskey Heirloom Varnish. To glass-stain the mirror, you'll need: eye droppers; carbon paper; full-size pattern; pencil; toothpick; one 4-oz. bottle of Titan's Liquid Lead. Also, one 2-oz. bottle of Glas Stain in each of the following colors: Amber (1)*, Lime (2), Emerald (3), Turquoise (4), Light Blue (5). *Numbers in parenthesis match color code in pattern above.



Practice on scrap material until you can apply the liquid lead in a uniform line.



Place the full-size pattern under the panel; trace the lines with the liquid lead.



Press down on the liquid lead with a toothpick so that all areas adhere to the panel.

painting. Bore vent holes at top and bottom. Cut and test-fit back (G).

Rip a length of $1\frac{1}{4}$ -in. round to suit for molding (D). Sand smooth.

Temporarily install panel (H) and tack-nail molding (D) to check fit. Note: If your decorative panel is sheet acrylic, allow expansion space when installing molding and cleats to prevent stress. Install hardware at back. Check parts for fit and disassemble.

Install the fluorescent lamps, making the connections as shown in

HOW TO ORDER GLASS STAIN PATTERNS

You can order full-size patterns of the decorative glass-stain panels used in these projects. Send check or money order payable to Popular Mechanics to Dept. GSP, Box 1014, Radio City Station, New York, N.Y. 10019. Specify pattern: Dragonfly (\$1.25 each), Casa (\$1.75 each) or Zodiac (\$1.95 each). Allow three to four weeks for third-class mail delivery. For faster, first-class mail, add 35 cents.

the drawing on page 98. Carefully locate lamps (J) to allow clearance between them and the front and

(Please turn to page 130)



Apply glass stain with eyedroppers. Hold tissue under dropper while carrying stain.

An expert's

by Otha C. Spencer



1 Glass-cutting tools available are (left to right): heavy-duty cutter with replaceable wheel; standard cutter with ball tip; standard cutter with replaceable wheel; multiple-head cutter; diamond cutter; glass-cutting hacksaw blade; glazier's pliers and circle cutter.

Now, before cold weather arrives, is the time to check your storm windows for cracked panes. Cutting glass to make these repairs simply requires practice.

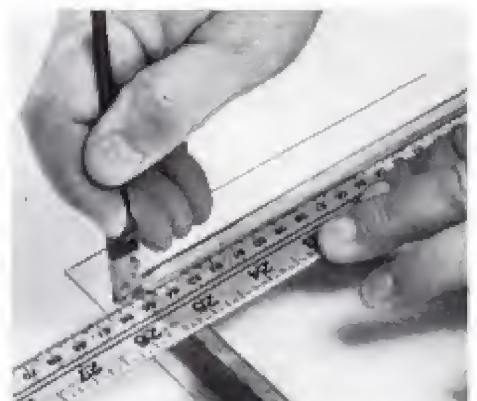
In truth, glass isn't really cut; it's broken. The cutting tool creates a fissure, a line of stress. Glass will snap along this fissure when you apply a bending pressure. Different types of glass cutters are available (photos 1 and 2).



2 The cutting heads shown are (from the top): heavy-duty cutter; standard cutter; cutter with replaceable wheel; multiple-head cutter and diamond cutter.



3 The cutting surface must be flat. The standard way to hold cutter is between index and middle finger. It's important to keep the cutter perpendicular to glass.



4 To get a good fit on a picture-frame glass, cut it over the frame. A straightedge with some strips of electrician's tape on the bottom is a good, nonskid guide.



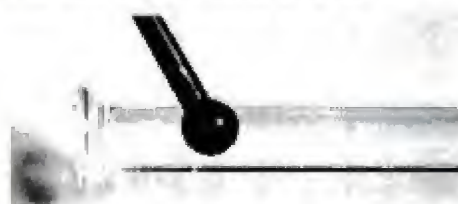
9 Hold the glass between thumbs and forefingers, close to the cut. For a clean cut, snap glass with bending motion.



14 Then place a small rod under the cut to make the break easier when you push down on each side of the glass.



7 With practice, you can also make curved cuts without using a guide by following a line. Just start the cut at an edge.



12 After scoring, break the rods by tapping them sharply with the cutter ball.



8 Tap the glass under the cut with the ball on the cutter handle. This starts the break and makes snapping apart easier.



13 Tap heavy mirrors or plate glass sharply after scoring to make glass break.

secrets for cutting glass

Although there are no flying glass fragments in normal glass cutting, it's wise to wear safety goggles and glass-handler's gloves or other gloves that permit a good grip.

Glass cutting tips

First, clean the glass. Use a razor-blade scraper, commercial glass cleaner or No. 4/0 steel wool to remove dirt.

Based on experience and contrary

The author is a professional picture framer and a member of the Professional Picture Framers' Assn.

to most instructions, I find that oiling the wheel isn't needed. Cutting wheels are oiled at the factory. This lubrication is sufficient for the life of the wheel. However, if you use your cutter infrequently, you might apply 3-in-1 Oil or kerosene to prevent rust. Remove this oil from the wheel before use.

The cutting table should provide firm, even support for the glass (photo 3). Cut over a sheet of corrugated cardboard or several layers of newspaper.

You can easily cut glass to size for

a storm window or a picture frame. Use the frame as a guide by cutting the glass over it (photo 4). Use picture frame with backside facing upward.

To make freehand cuts, or to cut special shapes (photos 6 and 7), first draw the shape on paper. Slip it under the glass and then make the proper cut.

Before cutting, run your thumb along the cut line (photo 5). This body oil provides lubricant to prepare the surface.

Cutting the glass

First make practice cuts on glass scraps. Using a rule as a straight-edge, hold the cutting tool perpendicular to the pane. Apply pressure and draw the tool across the glass. The cutter should make a small scratch.

Don't gouge the glass or push too hard. A skilled glazier can tell by the hissing sound of the cut if he is exerting the proper amount of pressure.

The wheel should roll smoothly. If it skips and makes an irregular line, the cutter is dull and should be replaced.

If you make an irregular cut, don't retrace it. Doing so will damage the wheel. Make another cut on the backside of the glass along the same line.

After making the cut, hold the glass in both hands between thumbs and index fingers, thumbs on top. If the glass is thick, tap it with the cutter ball to start the break (photo 8). Snap the glass apart with a bending motion (photo 9). The break should be clean and even, without rough edges.

Special glass cuts

Cutting a strip of glass less than 1/4-in. wide is a more difficult job. To make the break after scoring, grip the strip with glazing pliers or standard pliers with jaws wrapped in tape (photo 10).

You can use an ordinary cutter to cut glass rod (photos 11 and 12), and to cut plate glass and heavy mirror. After scoring, use the ball on the cutter to tap under the score to start the break (photo 13). Then place a 1/4-in. dowel or welding rod under the cut and push down on both sides of the glass (photo 14).

Sand rough edges with carbide sanding cloth (photo 15). Don't use a power sander as the glass may over-heat and break.



5 To get a good cut, the glass must be clean. After cleaning, oil the surface by running your thumb over the area to be cut.



6 To make a good freehand cut, follow a line drawn on paper under the glass. Keep the cutter perpendicular to the glass.



10 Use glazier's pliers to snap cuts near the glass edge. Or substitute ordinary pliers with masking tape on the jaws.



11 To cut glass rods properly, first score them with a cutter; then make the break.

Commercially cut glass

Some glass can't be cut with a household cutter. Tempered glass used in shower and oven doors must be cut before it's fired. Automotive safety glass, a sandwich of glass with a plastic core, must be cut on both sides. The plastic center is cut with a very thin blade.



15 Smooth rough edges of the glass with a medium-fine carbide sanding cloth on a block. Power sanders heat too much.

GLASS-CUTTER MANUFACTURERS

The Fletcher-Terry Co., Spring Lane, Farmington, Conn. 06032
Red Devil Inc., 2400 Vauxhall Rd., Union, N.J. 07083
Stanley Tools, Div. of The Stanley Works, New Britain, Conn. 06050

WORKSHOP MINICOURSE

USING A BENCH PLANE

Planing wood is one of the most enjoyable aspects of woodworking. One friend noted that he feels a real sense of accomplishment as he pushes a razor-sharp plane across a board to smooth its surface. As your skill increases, you will be able to set the iron quickly for cutting and to know the joy of producing long, thin shavings with minimal effort. Of

necessity, a plane will force you to learn how to read wood grain.

Before you put the plane to the board in a workshop session, take the time to inspect the blade to make sure it's set up as it should be. The cap iron should be fitted tightly against the blade, just behind its cutting edge. Installed correctly, the cap serves as a shavings deflec-

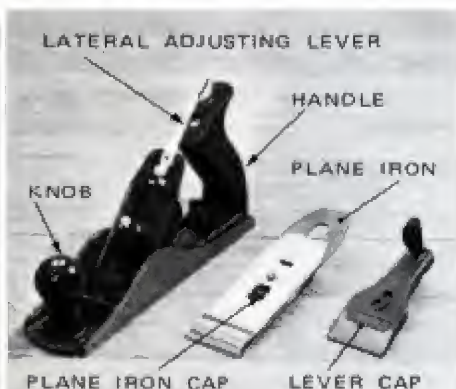
tor and assures continuous planing without clogging. A poorly fitted cap permits shavings to wedge between it and the blade, causing the plane to choke and cease cutting. By flipping up the lever cap and removing it, you can easily remove the blade and cap iron for an alignment check. If they're out of alignment, remove the assembly from the plane and disassemble. When you reassemble it, you should carefully follow the steps shown below.

Replacing the blade

When you put the blade back in the plane, make certain the cap iron is on top, and on the unbeveled side of the blade. Reinstall the lever cap and lock all in place with the small cam at the top.

To use a bench plane, grasp the front knob with your left hand and the handle with your right (unless you are left-handed). Grip the workpiece firmly in a vise; start each cutting stroke with the cutting edge off the workpiece. Try to run the length of the board in one stroke. Always aim for scant stock removal with each pass.

PM



Three major components of the bench plane include the tool pushed across the work, cutting-iron assembly and lever cap.



To assemble, place cap on the flat side of the iron with its screw in the slot.



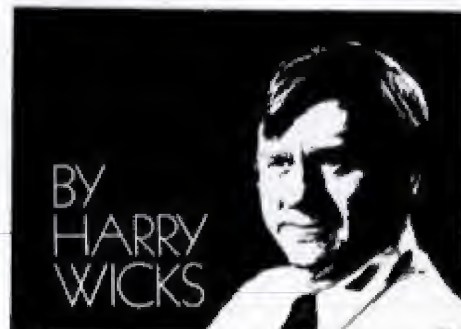
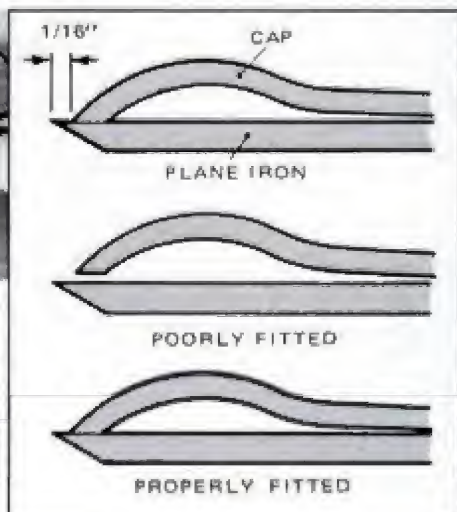
Plane iron (left) and its cap must be put together properly for efficient cutting.



Draw the iron back (above); then align it with plane iron as shown at right.



Push the iron cap forward until it is just behind the plane iron's cutting edge (see drawing, top right). The edge of the cap must fit tightly or shavings will wedge between the cap and the iron, and the plane will be choked (as shown above). When properly assembled, reinstall the iron in the plane and secure the iron with the lever cap.



BY
HARRY
WICKS

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The Getaway Stones

Remember, the performance of any tire is affected by inflation pressure, load, wear and operating conditions.



Super storage for your workshop hardware



Storing all your miscellaneous hardware in one place will save you time that might otherwise be spent searching. Baby-food-size jars on shelves built into doors are held in place with wire retainers and turnbuttons (arrow).

Another good title for this article might have been "organize your organizers." Most of us sort brads, screws, washers and the like into any containers we can get our hands on.

The trouble with this is that all these nicely sorted items don't get stored in one central location. They

are often scattered on shelves, in drawers and in cabinets. We all spend more time hunting for hardware than we would like to—and it's not uncommon to make a trip to the hardware store, only to turn up the required item afterwards.

C.E. "Doc" Banister, master craftsman and a regular contributor

to PM, came up with the solution shown here for his shop. He has organized his organizers in a single cabinet with a huge capacity. Unlike those commercial organizers, which provide plenty of compartments that are often too small for what you want to store, this cabinet will accommodate a variety of different

sized containers. One-stop storage of your miscellaneous hardware will save you a lot of hunting and cussing.

Building the cabinet

Start by cutting the side, top and bottom pieces for the main cabinet box and the door boxes. Cut rabbets at the ends of parts A and D and on the back edge of parts A and B for the cabinet back (I). Next, cut the dadoes for the shelves. Note that the shelf widths given will provide ample space for large jelly and peanut butter jars in the center and baby food jars in the doors. If your collection of containers isn't suited to these shelf heights and widths, change the dimensions to fit your requirements.

Assemble the boxes with an eye to keeping them square. Use 4d finishing nails and glue. Add the back to the cabinet.

Facing the doors

Make the cabinet door fronts 1 in. wider than the shelf box. This will allow them to meet at the center without interfering with the inner door sides (D) when opening and closing.

Dowels and glue can be used to

join the front frame members (G and F). Apply glue to rabbet and let in 1/8-in. A-C plywood (J), A side out. Clamp and allow to dry before adding retainers and turnbuttons.

Bend aluminum rod for the retainers, using a vise and bevel to obtain accurately spaced bends and the required angles.

See Detail 6 below for the measurements. Attach the retainers with wire clips and then install the turnbuttons.

Assemble the shelf box and door fronts with screws installed through sides D and E and into F. Counterbore and plug to hide the screw heads.

The front panel, of course, can be nailed instead of screwed to the shelf box.

Keep door hinges secure

Hang the doors next. If you anticipate a heavy load, use three hinges per door instead of the two shown in the plans.

In either case, it's a good idea to use nuts and bolts to install the hinges to keep them from pulling out of the sides.

The door pulls and the cabinet catches are a matter of personal preference. Although a clear finish

was used on the prototype, latex primer and an enamel top coat can be substituted.

Note: The photo at the top of the facing page shows the cabinet with facing, but since this restricted the swing of the doors, it was eliminated. All plan dimensions have been adjusted. **RM**

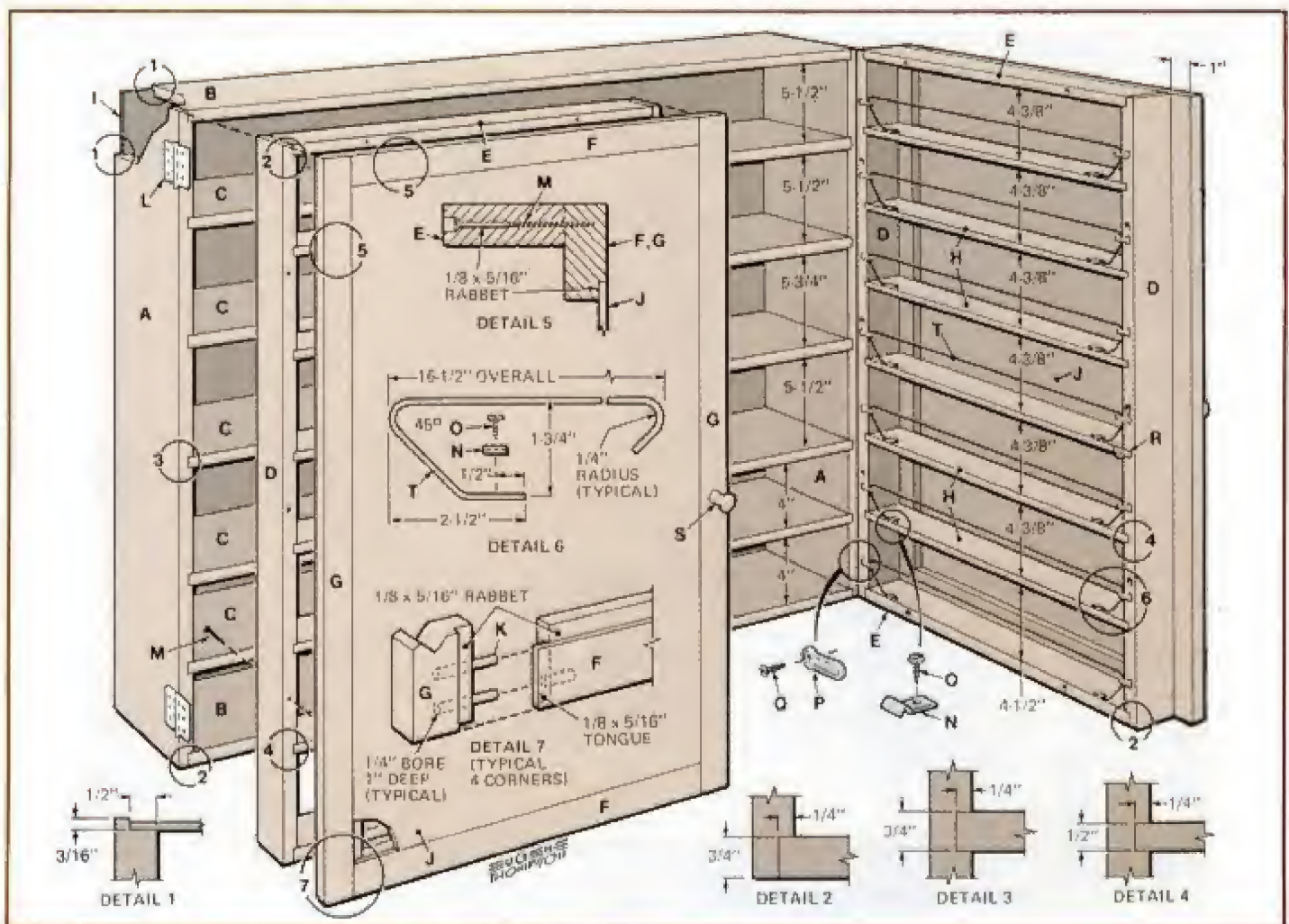
MATERIALS LIST—STORAGE CABINET

Key	No.	Size and description (use)
A	2	3/4 x 6 1/8 x 35 1/4" pine (cabinet sides)
B	2	3/4 x 6 1/8 x 38" pine (cabinet top and bottom)
C	5	3/4 x 6 1/2 x 38" pine (cabinet shelves)
D	4	3/4 x 2 1/4 x 35 1/4" pine (door top and bottom)
E	4	3/4 x 2 1/4 x 17 1/2" pine (door shelves)
F	4	3/4 x 1 1/2 x 18 1/2" pine (door frame, top and bottom)
G	4	3/4 x 1 1/2 x 35 1/4" pine (door-frame sides)
H	12	1/2 x 2 1/4 x 17 1/2" pine (door shelves)
I	1	1/2 x 34 1/2 x 38 1/2" tempered hardboard (cabinet back)
J	2	3/4 x 18 1/2 x 32 1/2" tempered hardboard or plywood (door front)
K	16	1/4"-dia. x 2" dowels (to reinforce joints)
L	4	3" loose pin door hinges
M	20	No. 10 x 2 1/2" fin wood screw
N	28	electric wire clip*
O	28	No. 6 x 3/4" sheet-metal screw
P	28	turnbutton**
Q	28	No. 4 x 1/2" fin wood screw
R	2	roller catch
S	2	knob
T	14	1/4"-dia. x 24" aluminum rod

Misc.: Nails, glue, baby food or jelly jars to suit.

*The electric clips are carried by most electric supply outlets.

**The turnbuttons are available from Craftsman Wood Service, 2727 South Mary St., Chicago, Ill., 60608.





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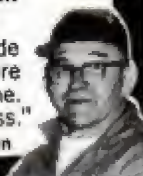
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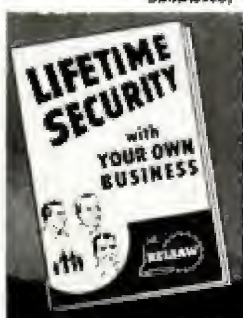
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Caning made simple

used to wedge it into the seat's groove. Spline comes in diameters of $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ in., with $\frac{3}{16}$ in. the most common.

To begin replacement, remove old cane from groove using a narrow chisel. Be careful not to enlarge the width of the original groove. Refinish the chair next, if you think it needs it.

Ordering machine-woven cane

To determine the size of the woven cane you need, add 2 in. to both the overall width and length of the original seat. Then measure the groove width to determine the diameter of spline needed. To find machine-woven cane, look in your classified directory. If you can't find a source there, order from Albert Constantine & Son, 2050 Eastchester Road, Bronx, N.Y. 10461; Craftsman Wood Service Co., 2727 South Mary St., Chicago, Ill. 60608; or The H.H. Perkins Co., 10 South Bradley Rd., Woodbridge, Conn. 06525.

With household shears cut the material roughly to shape, leaving the recommended allowance on all sides. Soak it in warm water (in sink or bathtub) for a half hour or more

so the cane will be pliable. Soak the spline for a few minutes, too. Fit it to the groove and cut it $\frac{1}{2}$ in. longer than needed.

Cut about a dozen wedges to hold the cane in the groove. Center the cane on the seat, making sure its glossy side is up and the pattern is not askew. Set the first wedges at front and back; do the same at the sides. Continue this procedure until the caning is taut.

Then use a wedge to force cane into the rest of the groove. Tap lightly with a mallet, being careful not to break the strands.

Glue for extra strength

With a sharp wood chisel, cut off the webbing at the outer edge of the groove and apply glue to the groove. Drive the spline in place using one of the wedges or another small piece of wood.

With a sharp knife, then cut the spline to exact length and drive down the end. The job will look neatest if the ends meet at the center of the seat back.

Wipe off surplus glue with a damp cloth and allow the finished seat to dry.—*Ralph S. Wilkes*



New seat in this chair is made of low-cost, machine-woven cane. Text tells how to replace split cane seats quickly and easily.

Take another look at that old chair with the hole in its woven seat. See if it has a groove around the edge of the woven portion with a spline in it. If so, machine-woven cane will make the repair easier and less expensive than you might think—even as little as \$3 or \$4 per chair.

Cane is available in long rolls, 12, 14, 16 and 18 in. wide. A spline is



Remove the old spline and cane with a narrow wood chisel and clean the groove, being careful not to chip the seat boards.



A high-speed rotary tool is also effective when you're cleaning the old caning material and the glue out of the spline groove.



Soak the spline for a few minutes in warm water, fit it to the groove and cut the length slightly longer than you will need.



Next, cut the machine-woven cane about 1 in. larger on all four sides than the dimensions of the area enclosed by the groove.



Stretch new cane seat into position using opposing wedges. Then use wedge and mallet to tap cane into remaining groove.



After using a sharp chisel to cut off the surplus cane, run a generous bead of glue in groove and drive the spline in place.

A passive solar collector anyone can build

A solar collector with a payback period of only two years? That's how long Prof. Bruce McQuarrie of Worcester Polytechnic Institute estimates it took before he received free B.T.U.s from the sun.

His passive collector is simply a double-glazed lean-to adjoining the south-facing wall of a house. As air is heated, it passes through an open window or vent at the top of the enclosure. Cooler air, drawn in through a basement window or vent, replaces the hot air. No active systems are involved—just convection (the transfer of heat by the movement of air). To prevent heat build-up in the summer, the collector is covered with white-painted plywood panels.

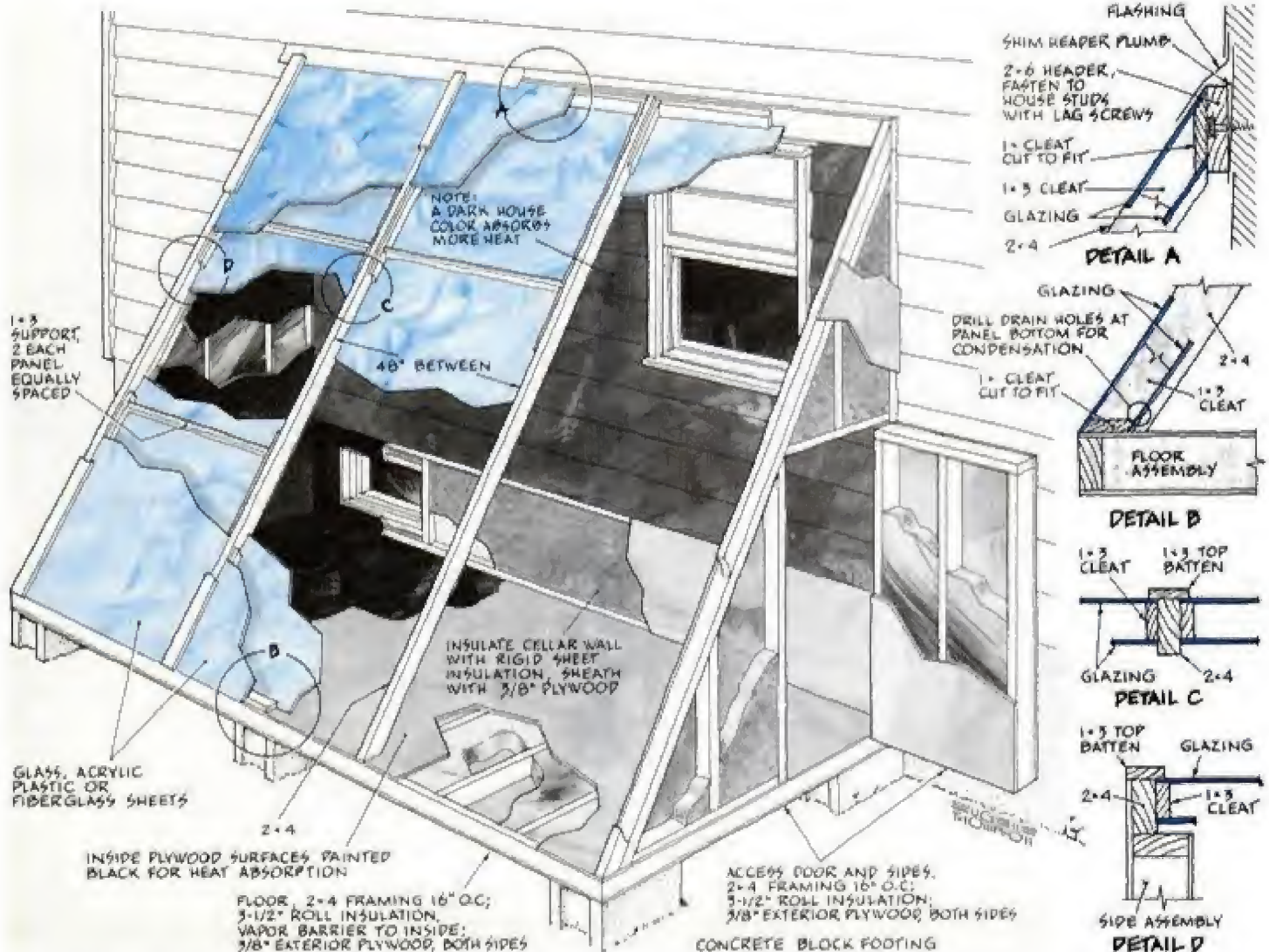
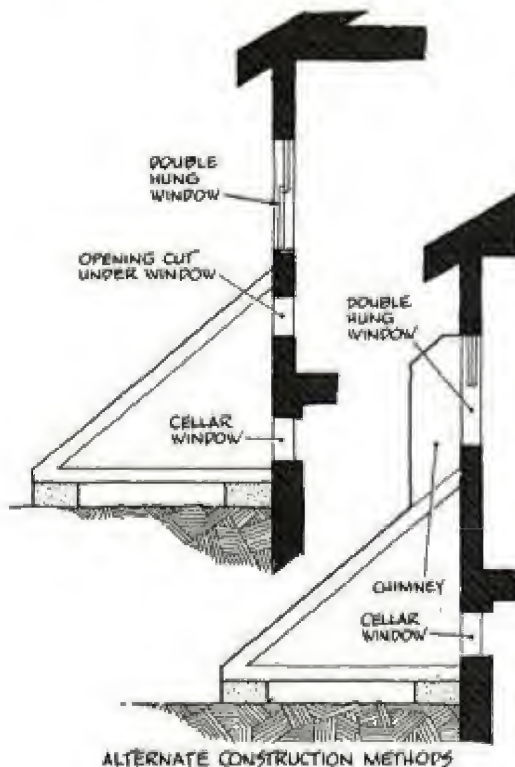
This design can work for you if you have a site that is not obstructed from the sun during the winter and windows that are appropriately spaced. The ideal arrangement is to have windows located at opposite corners of the enclosure.

Instead of permanently blocking a window, you may choose to cut a vent in the wall (about the same size as the basement window). Or, construct an insulated chimney or duct, connecting the window to the collector. The chimney can be removed in the summer.

To determine the best slope for your collector, add 15° to your latitude. (Measure slope from the horizontal.) Use two layers of translucent fiberglass for glazing and paint the floor of the collector black.

The fiberglass (Sun-Lite Premium II) is available in prepackaged rolls from Kalwall Corp., Solar Components Div., Box PM 237, Manchester, N.H. 03105.

Step-by-step building instructions are available from Worcester Polytechnic Institute, Public Relations Dept., Worcester, Mass. 01609. Enclose a self-addressed, stamped envelope.—*Joseph R. Provey, Assistant Home and Shop Editor*



Warning: The Surgeon General Has Determined
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FILTER 100's: 12 mg. "tar", 0.9 mg.
nicotine, av. per cigarette, FTC Report DEC. '79.

Build PM's rugged, lightweight garden cart

Whether hauling plantings, firewood or leaves, our sturdy cart will save your back.

by August Capotosto

Garden carts make yard and garden chores less of a strain. They can be used to move around everything

from balled shrubs to cordwood. A cart is also a lot easier to use than a typical wheelbarrow. You don't have to perform a balancing act with off-center loads because the weight is distributed to two wheels instead of to one. Carts are also easy to unload. To dump the contents, you simply lift the handle to flip the back end over the front.

Our model has front and side extension rails to keep large loads, such as trash bags full of leaves or clippings, corralled. They can be quickly removed when they're not required.

Old bike wheels save money

We used 20-in.-dia. front bicycle wheels for the prototype, but a wheel kit, including semipneumatic tires and $\frac{3}{4}$ -in.-dia. axle, is available for heavy-duty versions (see the materials list on page 112).

If you have a couple of old *front* bicycle wheels collecting dust, follow the instructions in the text for adapting them to the cart. The original wheel axles must be replaced with a single through-axle, which is not an item you can buy. It can,

however, be readily made by threading the ends of a length of $\frac{5}{16}$ -in. cold-rolled steel rod, a stock item in many hardware stores.

Or 24- or 26-in. wheels may be substituted without changing the basic design; the only effect would be a cart that rides slightly higher.

If you choose the wheel and axle kit, construction is simplified since fastening the wheel hubs to the axle requires no threading. The axle simply slips into the hub and is held from slipping with a cotter pin.

Starting construction

Cut plywood parts (A, B and C) to size. Assemble the sides and bottom first and then add the front, using 4d finishing nails and resorcinol glue. Since the angle iron has a fillet (rounded inside corner), round the corners of the box to permit the iron to make close contact with the wood. A router, block plane or rasp can be used to round the corners.

The angle iron corner reinforcements (I, J, K) go on next. Note that the front



PM photos: color, Harry Hartman; black and white, Rosario Capotosto

Side extensions, which slip easily into brackets, nearly double capacity of the cart. They are especially useful when totting large, bulky loads such as brush, and bags of leaves or trash.



bottom piece (I) is notched at the ends to allow a flush fit, without overlap, at the corner. You can make cuts easily with a sharp, coarse-tooth hacksaw. Bore holes for the carriage bolts.

Attach the side angle irons (J) temporarily and then cut the axle brackets (L) from the same stock. Bore holes for the axle and bolts. Insert the axle into the brackets and place the assembly onto the bottom of the box.

Be certain you carefully align the axle parallel to the front, and mark the holes for the bolts on the angle iron by tracing through the predrilled holes in the brackets.

Support blocks ease load

The two, wooden, axle-support blocks (G) are cut from 2x3s. These serve to prevent the axle from bowing under load. Make sure the holes in these blocks are at the same height as those in the brackets. Adjust location and axle-hole diameter shown in the plans if you use the heavy-duty wheel kit with $\frac{3}{4}$ -in. axle. Brackets are not required if you use the heavy-duty axle.

Next, cut the axle (Q) to length and cut the threads at each end (if you're using bicycle wheels). Note that axle thread size is not standard; some wheels have axles with 24 threads, and others have 26 threads per in. The cones which retain the wheel bearings will, accordingly, have either of these threads.

The $\frac{5}{16}$ -24 NC thread die is a common one, usually found in home-shop threading kits. The 26-thread die is not that common, and most local hardware stores do not stock it. Check the wheel-hub threading before assuming you can use the wheels you have on hand. Be sure you can obtain the required die before you start the project.

Assemble the parts thus far completed with the appropriate bolts, but don't over-tighten. You may want to dismantle the angle iron members so that you can do a neat, two-tone paint job of the entire garden cart later.

Adding the extensions

The extension rails are made with half lap joints, which can be cut with a few passes over a dado head. Use glue to join the parts. Clamps won't be necessary if you use four 18-ga., $\frac{3}{4}$ -in. galvanized brads on each side.

To make the stake retaining brackets (M), cut 12 steel strips to length. Then mark the four bend locations as indicated

HOW TO BUILD THE GARDEN CART



1 Use waterproof resorcinol glue and 4d (1½-in.) finishing nails to put together the three-sided body of the cart.



2 Due to fillet in angle iron crease, round the outside corners of the box with a block plane or rasp for close fit.



3 Position axle brackets, with predrilled holes, over the bottom angle irons to mark the locations for the bolt holes. In final assembly, two axle-support blocks keep axle from deflecting under loads.



4 If you use bike wheels, cut deep threads on both ends of a $\frac{5}{16}$ -in.-dia. rod. Use die to match threads in wheel.



5 When assembling side and front rails, use $\frac{1}{4}$ -in. galvanized brads, four on each side, to hold joint while glue sets.



6 To make the stake brackets, first bend steel strips into U-shapes in a vise; then bend the flanges at each end.



7 To finish the flange bend on each leg, press firmly with a scrap of wood.



8 Make this simple jig to bend the aluminum tubing. Index marks on the backboard and tube must align to assure making the bend at the desired location.



9 The second bend will form a U of correct width only if the second index mark was properly spaced as in plans.



10 Drive hardwood dowels into the ends of tubing for reinforcement. The $\frac{1}{4}$ -in. dowels require sanding to fit.

in the plan. Line up the mark for the first bend with the top edge of the vise jaw. Press sideways with scrap wood to form a right-angle bend. Then make the next bend to form a U-shape. Now, reinsert the pieces in the vise up to the second mark and make reverse right-angle bends. Drill holes for the roundhead screws in the brackets and pilot holes in the cart sides. Install the brackets.

Bending the handle and leg

The aluminum tubing for the cart handle (O) and stand (P) can be easily bent to shape with the simple jig shown in the plans and photos. However, in order to come up with U-shaped tubes with the proper inside-to-inside dimension, the bend marks must be spaced accurately and lined up carefully with the index marks on the jig. Also, be sure to clamp the tubing firmly in the jig. This will prevent the tubing from sliding during the bending operation.

Insert 12-in.-long dowels into the ends of the tubes to reinforce them at the bolts which join them to the cart sides. Drill the holes and install.

For a professional-looking paint job, you should remove all the metal parts and paint them and the wood components separately.

Construct a cart that will last

Since you're not likely to wheel your cart into the shed or garage every time it rains, take the following precautions to prolong its useful life:

1. Use only exterior-grade plywood.
2. Use two-part, resorcinol glue, available at good hardware stores, for all wood joints.
3. Use brass or galvanized metal fasteners. Ordinary steel will rust quickly and stain the wooden parts.
4. Be sure to paint unprotected metal parts with a rust-inhibiting primer and a compatible enamel top coat. Aluminum tubing need not be painted.
5. Seal all wood parts with a latex exterior primer.
6. Use an exterior latex enamel for the top coat. Spar varnish can be applied over the latex if an extra-durable gloss finish is desired.
7. If you leave the cart outdoors during the growing season, be certain to store it vertically so that it sheds, rather than collects, water.
8. During the off-season, store the cart in a shed. If this is impossible, place it upside down on blocks to keep it off the ground and cover it with either a tarpaulin or 6-mil. polyethylene.—J.P.

MATERIALS LIST—GARDEN CART

Key	No.	Size and description (use)
A	1	$\frac{1}{4}$ x 22 x 32" plywood (cart bottom)
B	1	$\frac{1}{2}$ x 12 x 23" plywood (cart front)
C	2	$\frac{1}{2}$ x 12 x 32" plywood (cart side)
D	2	$\frac{1}{4}$ x 2 $\frac{1}{4}$ x 21" (front extension rails)
E	4	$\frac{1}{4}$ x 2 $\frac{1}{4}$ x 28" (side extension rails)
F	6	$\frac{1}{4}$ x 2 $\frac{1}{4}$ x 22 $\frac{1}{2}$ " (extension posts)
G	2	1 $\frac{1}{2}$ x 2 $\frac{1}{2}$ x 5 $\frac{1}{2}$ " fir (axle brace)
H	4	$\frac{3}{16}$ -dia. x 12" dowel (insert)
I	1	$\frac{1}{2}$ x 1 $\frac{1}{2}$ x 1 $\frac{1}{2}$ x 23" (angle iron for bottom front)
J	2	$\frac{1}{2}$ x 1 $\frac{1}{2}$ x 1 $\frac{1}{2}$ x 31 $\frac{1}{2}$ " (angle iron for bottom sides)
K	2	$\frac{1}{2}$ x 1 $\frac{1}{2}$ x 1 $\frac{1}{2}$ x 10 $\frac{1}{2}$ " (angle iron for front edges)
L	2	$\frac{1}{2}$ x 1 $\frac{1}{2}$ x 1 $\frac{1}{2}$ x 5" angle iron (axle support)
M	12	$\frac{1}{4}$ x 1 x 6 $\frac{1}{4}$ " steel (bracket)
N	2	$\frac{1}{4}$ x 1 x 11 $\frac{1}{2}$ " steel (braces)
O	1	$\frac{1}{4}$ " o.d. x 72" aluminum tubing (handle)
P	1	$\frac{1}{4}$ " o.d. x 72" aluminum tubing (stand)
Q	1	$\frac{3}{16}$ -dia. x 31 $\frac{1}{2}$ " steel rod (axle)*
R	4	$\frac{3}{16}$ " hex nuts (axle nuts)*
S	2	20"-dia. front bicycle wheels*
T	18	$\frac{1}{4}$ x $\frac{1}{4}$ " carriage bolt, washer and nut
U	4	$\frac{5}{16}$ x 1 $\frac{1}{2}$ " carriage bolt, nut (4 reqd.)
V	4	1 $\frac{1}{2}$ " No. 8 flt wood screw
W	4	$\frac{1}{4}$ x 1 $\frac{1}{2}$ " hex-head bolt, nut
X	4	$\frac{1}{4}$ x 1 $\frac{1}{2}$ " hex-head bolt, washer and nut
Y	24	$\frac{1}{2}$ " No. 8 pan-head screw

Misc.: 4d finishing nails; $\frac{1}{4}$ " galvanized brads; resorcinol glue; scrap lumber for bending jig.

*Heavy-duty wheel and axle kit, including semipneumatic tires and a $\frac{3}{4}$ -dia. axle, is available from J.H.B. Kits, 10405 Wallace St., Kansas City, Mo., 64134. The postpaid price is \$48. The 20-in. front bike wheels, with $\frac{1}{2}$ -24 axle components, can also be purchased from Sears, Roebuck and Co. The bike wheels cost about \$9 each, and don't include tires, tubes or the cart axle.

5 garden carts you can buy



A 10-in.-dia. inflatable ball takes the place of a wheel on this Ballbarrow. Its body is rustproof and dentproof, and made of molded polyethylene plastic with a capacity of 3 cu. ft. (\$45 postpaid) or 4½ cu. ft. (\$58 postpaid). The models weigh 18 and 20 lbs., respectively. The ball-wheel doesn't get mired in mud and is less likely to leave tracks across soggy surfaces, according to the firm. It's available at garden centers or direct from the Ballbarrow Corp., 1320 Ardmore Ave., Itasca, Ill. 60143.

The Big Tote folding lawn cart has a large, 25-bushel capacity for leaves and trash. Its sides fold flat to take up minimal storage space. The body is bonded, vinyl-coated fabric that's mildew-resistant. Simply lay the 36-in.-wide open end on the ground and rake in debris. Cart is designed for easy, roll-over unloading. It's priced at \$75 in lawn and garden centers from Hall Industries Inc., 2323 Commonwealth Ave., North Chicago, Ill. 60064.



Built of heavy-gauge galvanized steel, the Stow & Go folding garden cart carries grass clippings in summer and firewood in winter. To store, it folds flat on rugged piano hinges at all folding points and takes up one-fifth the space of conventional carts, according to its makers. Hang it or slip it flush against a wall. The 4½-cu.-ft. model costs \$63; the 6½-cu.-ft. model is \$80. W.C. Bradley Enterprises Inc., Box 1240, Columbus, Ga. 31902, makes the Stow & Go.



You can store yard and garden gear in the Tool Mobile and roll it directly to the work spot when you need it. A large bucket with snap-in dividers holds sacks and boxes. Coil retainers near the handle firmly hold long- and short-handled tools. Two side hooks secure hoses and cords. A hanging, compartmented tool holder stores small tools at your fingertips. The Tool Mobile is \$70 and is made by Great Outdoors, Consumer Div. of Slater Products, 301 Riverside Ave., Westport, Conn. 06880.

This multipurpose Leisure-Cart has a polyethylene body that is sturdy enough to be pulled by a tractor. The cart weighs 100 lbs. and holds 16 bushels of piled debris. Accessories turn it into a dining table (below) or a surrey (right). Basic cart is \$250 plus freight; cart with accessories (fringed canopy, serving counter, table extension, seat, cushion and hand-pulling handle) is \$400 plus freight, from Exton Technology Corp., 288 Lancaster Pike, Malvern, Pa. 19355.



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PYROTECHNICS TO SAVE YOUR LIFE

(Continued from page 87)

long or more, or carrying up to six passengers.

Exceptions: All boats in marine parades, regattas, races or similar organized events; manually propelled boats; all open sailboats under 26 feet, without cabin or cuddy, and with no propulsion machinery.

Between sunset and sunrise, everybody must carry approved signals—including all those boats specifically exempted above, and also all boats under 16 feet.

New rules for coastal waters

2. The new regulations apply only to coastal waters. Definition: Territorial seas, bays and sounds opening directly or indirectly to the sea; coastal rivers more than two miles wide at the mouth—up to a point where width drops below two miles—and the Great Lakes. Specifically exempt are marshes, bayous and saltwater ponds.

3. Distress signals must be approved, chosen from a particular list, accepted for specific uses, and carried in the quantity indicated below. (They will probably be packed that way.)

Days only: Floating orange smoke (3); hand-held orange smoke (3); orange flag (1).

Nights only: Electric, automatic SOS signal light (1).

Days and nights: Pistol-projected red parachute flare (3); hand-held rocket-propelled red parachute flare (3); red aerial pyrotechnic flare (3).

Important note: You do not have to carry all of these. Select what you need. You'll meet the letter of the law, for example, with just one orange distress flag for day use and one automatic, electric SOS signal for night (if carrying fireworks aboard worries you).

Note also the old hand-held red flare (fusee) is out, as of now. It may be reinstated following extensive Coast Guard testing and a final determination on the hazards of slag.

What about signal devices you already have? Red flares may not be approved, but red aerial flares, pistol-fired or rocket-propelled, and hand-held or floating orange smoke will be "grandfathered" in until July 1, 1982—if they remain in usable condition.

You may be happier switching to the Coast Guard-approved devices as soon as they are announced. Pyrotechnic gadgetry, for example, must meet rigid intensity and burn-time requirements, and will be superior.

The Coast Guard also took a close look at flare pistols. Some cheapies,

in the past, have not worked, and others were in violation of firearms laws, causing grief for a small number of skippers. New Coast Guard-approved pistols will be reliable, and will be incapable of chambering standard firearms ammunition.

Wanted: signal disposal plan

Your pyrotechnics will have clearly marked expiration dates—42 months from the date of manufacture. Then you replace them, but unfortunately, the regulations don't provide a legal way of disposal. You can't fire a distress signal unless in actual distress, or you break the law. Toss them in a garbage can or light them off in your back yard and you'll be in trouble with municipal authorities.

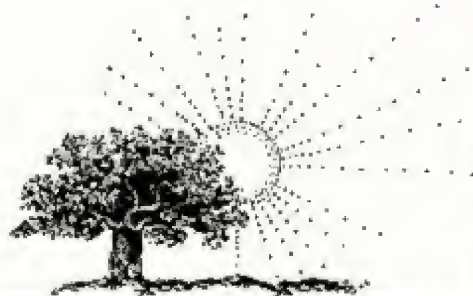
Experienced skippers will continue to carry the aerial flares that have proved so effective offshore at night. But others will choose the nonincendiary flag and SOS light that the regulations allow. The flag is a variant of the old Canadian surface-to-air signal. The shortest side must be 90 centimeters (36 inches); it can be square, but if it's a rectangle, it must have a width-to-length ratio of 2 to 3. It will display a large black ball and black square on a bright "red-orange" background.

The Coast Guard doesn't trust a skipper in distress, bilges flooding and ankles already awash, to properly time his flashlight signal of three dots, three dashes and three dots for an SOS. But since an erratic signal could easily be confused with background lights on shore or a navigational aid in a heaving sea, the Coast Guard specifies automatic flashes of one-third of a second for dots, one second for dashes, one-third for dark periods between flashes, two seconds between letters, and three after each SOS. A flag and flashlight are likely to be the easy way out for many boatmen.

During the period when these new distress signals were being decided on, a typical comment was, "If one chooses to go sailing, he has no right to expect anyone else, especially the government, to save him."

Such attitudes change, needless to say, when the hull starts flooding. The Coast Guard's reply merely said, "... Experience has shown overwhelmingly that prompt rescue efforts are expected, often at considerable expense to the government," and that proper visual signaling devices should make rescues "more successful and of shorter duration."

PM



JOIN THE MOTHER EARTH NEWS® AT A SERIES OF PRACTICAL SUMMER SEMINARS

As the cost of living continues to soar and the availability of fossil fuels becomes more and more doubtful, lots of folks are coming to believe that it's high time we returned to good old proven techniques of achieving self-sufficiency, as a way out of the economic and ecological pitfalls we're stumbling into.

And that's why THE MOTHER EARTH NEWS® was begun a decade ago: to help you explore alternative lifestyles and learn the kind of practical skills that can make your life fuller, more in harmony with the environment . . . and more nearly under your own control! To achieve such goals, we publish a bi-monthly magazine that's jam-packed with useful articles . . . we conduct our own research in such areas as alternative fuels (in fact, MOTHER's highly successful alcohol fuel seminar—featuring an operative 6-inch column still—is currently touring the country) . . . and we're hosting a whole series of informative seminars this summer, to be held right here at MOTHER's 622-acre research Eco-Village in the western North Carolina mountains.

This, our second annual summer seminar program, has been expanded to include even more classes offering hands-on technical experience . . . and we've gathered experts from across the country to give you all the "how to" you'll need to "do it yourself". Here's a rundown on a few of these exciting seminars.

THE SOLAR GREENHOUSE

Before you sink your own cash into one of these units, you'll have the opportunity—in this seminar—to examine (and work inside) the passive structure that MOTHER operates. In addition, you'll have a chance to inspect some hot and cold frames.

CONTRACTOR-BUILT EARTH-SHELTERED HOMES

This one (with no real "roll up your sleeves" work) is tailored for architects, contractors, and others from the housing industry who want to know the advantages (and disadvantages) of earth-sheltered houses. The emphasis is on building with precast and poured-in-place concrete, fiberglass-reinforced panels, treated wood, and reinforced concrete block.

DO-IT-YOURSELF EARTH-SHELTERED HOMES

Here's your chance to get actual firsthand experience in the construction of underground housing. You'll gain a solid working knowledge of substantial, waterproof—and low-cost—earth-sheltered homes.

RESIDENTIAL SOLAR SYSTEMS

This information-packed three-day seminar features a visit to MOTHER's operative solar greenhouse and a look at scale models of passive structures. Plus hardware and audiovisuals of active residential systems that you can construct.

LOW-COST SOLAR HEATING SYSTEMS

You'll examine several efficient working systems that anyone can build from little more than junkyard scrap—and get hands-on experience with solar water heaters, sun-powered trackers, heat storage units, solar cookers, etc.

SMALL HYDROELECTRIC SYSTEMS

A popular course last summer, this one features a working water-powered turbine and other hardware. You'll measure a stream and design your own homestead-sized hydro system.

SMALL WINDPOWER SYSTEMS

Another 1979 winner, this class will demonstrate real Savonius rotors—a Jacobs windpump feeding a bank of storage batteries—and other hardware you can take apart and put back together again.

FARMER'S ALCOHOL

This day-long session offers theory, math formulas, and still design plus hands-on experimentation under the supervision of one of our expert alcohol makers. You'll watch as fuel is produced in MOTHER's 6-inch column still.

METHANE PRODUCTION AND USES

MOTHER has been working with this natural energy source since way back in 1972—and we'll show you how to operate gaslights, refrigerators, stoves, and even auto engines on a fuel made from virtually any kind of organic waste.

STEAM ENGINES

Look over the solar-powered steam engine that our researchers built from an old refrigerator compressor—fire up a 20-hp scummer and watch it run MOTHER's sawmill—use our solar furnace to drive prototype steam engines—and MORE!

AND THAT'S NOT ALL

A complete, detailed workbook or text will be provided to you in each and every class you attend—and you'll have enough free time to explore MOTHER's beautiful mountain property. Daily child care—for young'uns up to 12 years of age—will be available and you can reserve camper parking or tent space within the Eco-Village.

However, the number of seats for each seminar is limited. So send in the accompanying form today—and get ready to take your future into your own hands.

YES! I want to reserve the following number of seats for the following three-day seminars:

(write number of seats desired in each box)

FIRST JULY (July 14, 15, 16) SEMINAR ON	<input type="checkbox"/> RESIDENTIAL SOLAR SYSTEMS	<input type="checkbox"/> DO-IT-YOURSELF EARTH-SHELTERED HOMES	<input type="checkbox"/> CONTRACTOR-BUILT EARTH-SHELTERED HOMES
SECOND JULY (July 17, 18, 19) SEMINAR ON	<input type="checkbox"/> RESIDENTIAL SOLAR SYSTEMS	<input type="checkbox"/> DO-IT-YOURSELF EARTH-SHELTERED HOMES	<input type="checkbox"/> CONTRACTOR-BUILT EARTH-SHELTERED HOMES
FIRST AUG. (Aug. 11, 12, 13) SEMINAR ON	<input type="checkbox"/> RESIDENTIAL SOLAR SYSTEMS	<input type="checkbox"/> DO-IT-YOURSELF EARTH-SHELTERED HOMES	<input type="checkbox"/> CONTRACTOR-BUILT EARTH-SHELTERED HOMES
SECOND AUG. (Aug. 14, 15, 16) SEMINAR ON	<input type="checkbox"/> RESIDENTIAL SOLAR SYSTEMS	<input type="checkbox"/> DO-IT-YOURSELF EARTH-SHELTERED HOMES	<input type="checkbox"/> CONTRACTOR-BUILT EARTH-SHELTERED HOMES
FIRST SEPT. (Sept. 15, 16, 17) SEMINAR ON	<input type="checkbox"/> RESIDENTIAL SOLAR SYSTEMS	<input type="checkbox"/> DO-IT-YOURSELF EARTH-SHELTERED HOMES	<input type="checkbox"/> CONTRACTOR-BUILT EARTH-SHELTERED HOMES
SECOND SEPT. (Sept. 18, 19, 20) SEMINAR ON	<input type="checkbox"/> RESIDENTIAL SOLAR SYSTEMS	<input type="checkbox"/> DO-IT-YOURSELF EARTH-SHELTERED HOMES	<input type="checkbox"/> CONTRACTOR-BUILT EARTH-SHELTERED HOMES

I WANT TO RESERVE THE FOLLOWING NUMBER OF SEATS FOR THE FOLLOWING ONE-DAY SEMINARS

(write number of seats desired in each box and indicate date desired in the blank)

<input type="checkbox"/> MAKING AND USING FARMER'S ALCOHOL (JULY 14, 17, AUG. 11, 14, SEPT. 15, 18)	<input type="checkbox"/> METHANE PRODUCTION AND USE (JULY 15, 18, AUG. 12, 15, SEPT. 16, 19)
<input type="checkbox"/> THE SOLAR GREENHOUSE (JULY 14, 17, AUG. 11, 14, SEPT. 15, 18)	<input type="checkbox"/> SMALL WINDPOWER SYSTEMS (JULY 15, 18, AUG. 12, 15, SEPT. 16, 19)
<input type="checkbox"/> STEAM ENGINE CONSTRUCTION AND USE (JULY 15, 18, AUG. 12, 15, SEPT. 16, 19)	<input type="checkbox"/> ULTRA LOW-COST SOLAR HEATING SYSTEMS (JULY 15, 18, AUG. 12, 15, SEPT. 16, 19)
<input type="checkbox"/> SMALL HYDROELECTRIC SYSTEMS (JULY 15, 18, AUG. 12, 15, SEPT. 16, 19)	

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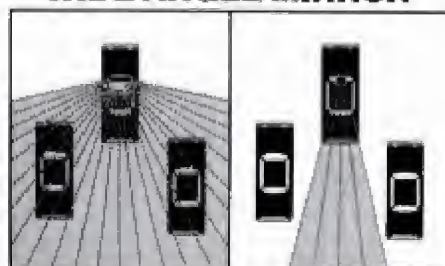
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NEW BLOWUPS THAT SAVE

(Continued from page 71)

big seas. Dinghies, runabouts and kayaks that inflate can blow over when a gust of wind gets under the bow, and pound passengers as the flat bottoms slap over choppy seas. Now, many makes incorporate a semi-deep-V shape with an inflated or fixed keel to help ease the ride.

Blowups are beginning to be classified into four grown-up groups.

■ Dinghies, oval doughnut in shape, usually rowed or paddled.

■ Fixed-transom models that can mount an outboard motor: divided into small runabouts under 12 feet, 12- to 15-footers and craft over 15.

■ River boats and whitewater rafts.

■ Last is a catch-all category that includes inflatable canoes, catamarans and kayaks.

Some craft in each of these groups can be rigged for makeshift sailing. Several kayaks and canoes have lace-on cockpit covers to protect passengers and gear aboard. Metzeler's Spezi L is a true one-man kayak with round center-deck cutout for the paddler and inflated decking and bottom.


The new synthetics that give the extra strength, lightness and durability to inflated boats also help prolong their life while deflated. Backyard or boatyard storage is not necessary for inflatables, of course. Even the smallest apartment usually can accommodate one, and a backpack or compact car can get most models to the water. Once a modern blowup comes out of the closet, the creases smooth out more easily and fatigue and cracks are less likely to show up in the fabric. Maintenance usually means washing salt and sand off the boat and letting it dry in the shade before storage. New pumps powered by a car battery speed up reinflation so that cartopping or trailering usually isn't necessary.

PM

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- Achilles, 25 Branco Rd., East Rutherford, N.J. 07073.
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Boston Whaler, 1149 Hingham St., Rockland, Mass. 02370.
Callegari-BMCD, 19100 Susana Rd., Compton, Calif. 90221.
Camp Ways, 12915 South Spring St., Los Angeles, Calif. 90061.
Explorer, Box E, Tecumseh, Mich. 49286.
Leisure Products, 1044 Northern Blvd., Roslyn, N.Y. 11576.
Maravia, Box 395, 857 Thornton, San Leandro, Calif. 94577.
Marine Union-Starcraft, 2703 College Ave., Goshen, Ind. 46526.
Metzeler, Box 15536, Pittsburgh, Pa. 15244.
National Recreational Prod., Box 5488, Lenexa, Kan. 66215.
Norwood, 67 Teed Dr., Randolph, Mass. 02368.
Novurano, 12511 Bealrice St., Los Angeles, Calif. 90066.
Sea Eagle-Leisure Imports, 194 Arlington Ave., St. James, N.Y. 11780.
Sempell-SDP 80 Field Point Rd., Greenwich, Conn. 06830.
Seylor, 6802 Watcher St., Los Angeles, Calif. 90040.
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PM DESIGNS A WORD PROCESSOR

(Continued from page 79)

find all occurrences of XYZ Inc. and replace them with ABC Unlimited. You can replace every occurrence, or, if you'd rather, you can approve or disapprove each change individually. This feature is also useful as an instant index simply to find a word or name within a report.

The features above are common to the two programs, but Super Text and Apple PIE have differences too. Here are a few:

■ **Math.** Super Text includes a math "module." This allows you to total columns of figures and calculate arithmetically as you are typing in the text and numbers, a certain advantage in many circumstances.

■ **Memory insertions.** Both programs allow you to store parts of the text in memory. Then the stored paragraphs or words can be inserted repetitively in the text. If you do forms made up of repetitive phrasings, this can be a help. We found the Apple PIE system more versatile in this respect.

■ **Split Screen.** Super Text allows you to see, and work on, two sections of the text at once. This gives you absolute control over the logical flow of the text.

■ **Keyboard.** Super Text has one-stroke keying of the word "the." Many of the keys control more than one function, depending on what "mode" the user is in. Apple PIE assigns a different key to every function.

Super Text is easier to learn, but Apple PIE quickly becomes second nature. Your best course of action is to find a computer store that sells both programs and have them demonstrated for you.

The printed version

The above programs allow you to type in, and correct, your text. The next step is to get it off the computer screen and onto paper. (In 20 years, this step will no longer exist as almost all offices and homes will have computer terminals instead of paper. But for now . . .)

Sending the text from the computer to the printer calls for an "interface card." We like the California Computer Systems card (see box, page 79).

Choosing a printer is a major decision, as it is one of the most expensive components. We like the Heathkit H-14 for a variety of reasons. First, available in kit form, it is the most inexpensive quality printer we know of. Even purchased assembled, its price is lower than most comparable printers. It is a "full-

size" printer, meaning it can print an 8½-inch-wide sheet of paper. It does, however, use a dot-matrix style of type, which is used in the blurb and byline of this story, just below the headline on page 78. You can get clearer printing from a more expensive printer. In fact, for another \$3000, you can buy many printers that will give results like type that appears on a printed page in a book or magazine.

We found the H-14's type to be acceptable for all but the most formal communications. The H-14 is low enough in cost, high enough in quality, to rate as a "best buy."

Remember that we pointed out that the interface card sends signals to the printer. Well, all printers and cards are different and may require modifications to work together. Some combinations may prove completely impossible to get working. The H-14 requires one small modification to work with the interface card. (Reverse pins 7 and 4 in the RS-232 cord when building the H-14.

Do not try other printer and card combinations on your own. If you buy a different printer or card, be sure you see everything working along with the software before you buy.

Now process some words

The system we show will, in many ways, compete with the \$50,000 business systems and will outperform some of the \$15,000 ones. There are, of course, advantages to the big systems. For one thing, the Apple II displays only 24 lines of 40 characters. The business machines will show approximately 100 lines of 80 characters each. But here is something extra: When you turn off your word processor, you will be left with an Apple II personal computer capable of a thousand and one other chores besides those involving word processing.

Word processing and personal computers are no longer in the future. Now you, too, can enjoy and put to work the fruits of 20th century technology.

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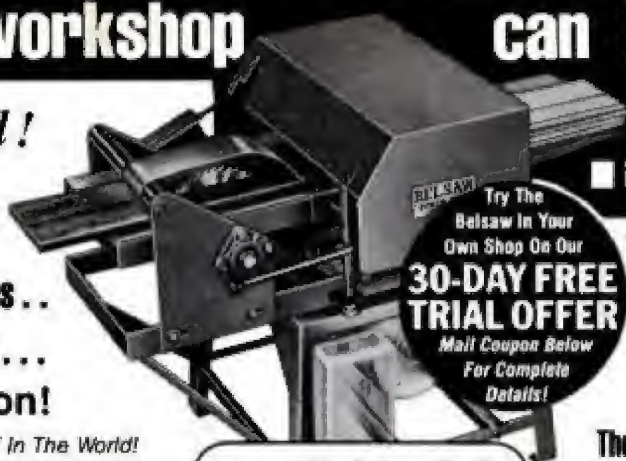
Apple Computer Inc., 10260 Bandley Dr., Cupertino, Calif. 95014. Apple II computer and Disk II drive.
Enhance Ware, Dan Paymar, Box C109, C.S. 6800, Costa Mesa, Calif. 92627. Lower-case adapter.
Heathkit Co., Benton Harbor, Mich. 49022. H-14 line printer.
Hobbyworld Electronics, 19511 Business Center Dr., Northridge, Calif. 91324. California Computer Systems printer interface. (Ask for the CCS asynchronous serial interface.)
Mountain Hardware, 300 Harvey West Blvd., Santa Cruz, Calif. 95060. ROMplus card (optional).
Muse Software, 7112 Darlington Dr., Baltimore, Md. 21234. Super Text.
Programma International, 3400 Wilshire Blvd., Los Angeles, Calif. 90010. Apple PIE Version 2.0.

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 Stephen Schultz — Orangeville, Penna.

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 Robert Sawyer — Roseburg, Oregon

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 Workbench Magazine

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enough travel. We also like the digital instruments and read-outs. As for complaints, we have none at all."

(A Ford product planner told PM recently that the standard Thunderbird seats are being redesigned and will please more owners in 1981.)

A Texas telephone installer: "I drove to Oklahoma City recently—a 10-hour drive—and wasn't even tired. Try that in another car! I don't have Complaint One about the T-Bird. I like its good gas mileage, quiet and comfortable ride, good handling and beautiful styling."

About workmanship, 62.4 percent of the owners we surveyed rated the Thunderbird good to excellent. That figure shows a satisfaction level some 30 percentage points below that for cars like the VW Rabbit, Honda Accord and Toyota Tercel.

A Louisiana restaurateur moaned, "I buy a new car for \$9600, and four months later a headlight cover pops off, the dashboard rattles, the clock stops and the power windows don't work. It scares me. Even the mechanics who work on this car express disbelief at the quality. The Thunderbird is the first car I've ever owned where I feel I've been taken!"

As our boxscore indicates, owners' rat-

ings of dealer service varied widely. A South Carolina meat cutter whose engine had to be replaced because of a bad connecting rod said, "My dealer is excellent. He did all the work I asked him to do and gave me back the car with the new engine



Limited front-seat travel boosts rear legroom but the seat belts restrict your exit.

in three days. He really went out of his way to help."

On the other hand, a nurse from Kentucky had nothing but trouble with her car and her dealer. "At first he tried to help. But when the car continued to break down, he gave up trying to make the car right. He told me to expect these problems with the new cars and I should just live with it. I might add we sold the car and took a \$2500 loss." Even with all these problems, she admits she still loves the car's looks.

Several T-Bird owners called our attention to the lack of space between accelerator and brake pedals. People with large shoe sizes say it's too easy to hit both pedals at once. An Ohio retiree, among others, suggests, "All they have to do to solve the brake/accelerator clearance problem is to offset the brake pedal a little to the left."

Another frequent plea from owners involved front-seat headroom. "The seat ought to be about 2 inches lower," suggested a Michigan travel agent. "I have the manually adjustable seat but tried a car in the showroom with the six-way power seat, and that one wouldn't go down low enough either."

However, despite these and a few oth-

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er grumbings, most owners expressed satisfaction and pleasure with their cars. "I'm very pleased in general with my T-Bird," said an Alabama sales coordinator. "I like the way it handles on the road; it has good pickup for passing, is comfortable, and has given me good service in 21,500 miles of driving. I travel approximately 3000 miles a month in my job, and

so far I haven't had any major problems."

And a Texas janitor: "The Thunderbird is just great for my needs and travel. I've driven Ford products for 30 years. This T-Bird, being smaller and more economical, caught my eye. I find it very cooperative and easy to handle, especially to get me around town."

And a Texas telephone repairman says: "My son and I both bought an '80 T-Bird, and they're just the best cars we've ever owned. Neither of us had the slightest problem and the mileage is great."

In all, 81.7 percent told us they wouldn't hesitate to buy another Ford product; 72.3 percent said they'd go for another Thunderbird. **FM**

SUMMARY OF 1980 THUNDERBIRD OWNERS REPORTS*

Total miles driven 933,860

Average miles per gallon

4.2-liter V8
In town 16.2
Long trips 21.5
5.0-liter V8
In town 15.3
Long trips 21.9

Engine choices:

4.2-liter V8 60.8%
5.0-liter V8 39.2

Why did you choose the Thunderbird?

Styling 46.4%
Had owned before 24.9
Economy 23.2
Size 15.5
Price 6.1
Comfort 6.1

Specific likes:

Styling 45.1%
Handling 42.3
Economy 33.1
Ride 24.0
Comfort 21.7

Specific complaints:

No complaints 30.3%
Lower-than-expected mpg 12.4
Poor workmanship 10.7
Harsh ride 9.0
Lack of headroom 6.2
Brake too near gas 6.2

What changes would you like?

No changes 20.9%
More headroom 9.2
Better gas mileage 6.7
Styling, especially rear 6.1
More legroom 4.9
Better materials 4.9

Workmanship opinion:

Excellent 20.9%
Good 41.7
Average 16.6
Fair 5.9
Poor 15.0

Comfort opinion (front seats):

Excellent 38.0%
Very good 30.4
Good 17.4
Fair 8.7

Poor 5.4

Comfort opinion (rear seats):

Excellent 23.9%
Very good 34.4
Good 16.0
Fair 17.2
Poor 8.6

Had any mechanical trouble?

No 56.0%
Yes 44.0

What type of trouble?

Headlight doors 19.8%
Oil leaks 11.1
Electrical 11.1
Brakes 9.9
Transmission 8.6

Dealer repairs satisfactory?

Yes 57.3%
No 42.7

Dealer service opinion:

Excellent 33.7%
Good 26.7
Average 13.5

Fair 11.2

Poor 12.9

Number of vehicles owned:

Thunderbird only 45.7%
Two cars 41.5
Three cars 10.1
Four or more cars 2.7

Makes of other cars owned:

Ford 49.0%
Chevrolet 14.7
Lincoln 8.8
Mercury 8.8

Age distribution of owners:

15-29 years 12.8%
30-49 years 41.3
50-plus 45.9

Would you buy another Ford product?

Yes 81.7%
No 18.3

Would you buy another Thunderbird?

Yes 72.3%
No 27.7

*Percentages might not equal 100% due to rounding or insufficient data.

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Patio Pal™

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Bugs have a "fatal attraction" to Patio Pal's "black light blue"

Deep in the heart of mosquito country in Florida, USDA scientists discovered a lure that flying insects find irresistible. They call it "black light blue". This remarkable light actually attracts hundreds of different types of flying insects from up to a third of an acre.

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Just plug Patio Pal in using ordinary household current, place it about 25 feet from where you're relaxing, and it immediately begins to draw bugs away from you. Mosquitoes, gnats, flies, even beetles and wasps are drawn like a magnet to Patio Pal's "black light blue". Once they're up close, a downdraft created by a powerful hidden fan, sweeps them inside and into a pan of water where they're quickly drowned. No chemicals, no smelly citronella candles, no mess, and best of all, no pesky bugs!!

Stay outside as late as you like!

Imagine! All day long and late into the night, you and your friends and family can sunbathe, picnic, barbecue, play tennis or cards, do as you please without bothersome bugs buzzing around. Even after a summer rainstorm, bugs won't bother you with Patio Pal around!

Ecologically safe

Yes, Patio Pal's no-chemical operation means there are no pollutants to harm your vegetable or flower garden. No worry about kids or pets. Patio Pal works on bugs only. What's more, you just empty the pan of water into the garden or grass about once a week and let the birds snack on the insects! Truly, the safest, most effective bug killer ever. Listed by Underwriters Laboratory.

Built to last for years

Yes, Patio Pal is quality constructed to be virtually impervious to bad weather and wear. And what a great bargain at just \$49.95. That's up to \$100 less than many electric bug killers.

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Still a trifle skeptical? No problem! We're so certain that you'll be 100% delighted with Patio Pal's fatal effect on bugs, that we're inviting you to test it in your own backyard for 15 days. If not thoroughly impressed, you may return it for a prompt refund.

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BOMBS BURSTING IN AIR

(Continued from page 66)

confetti-like bits that burn quickly to ash and fall harmlessly.

Centuries of big bangs

After the legendary Chinese origin, the first definite knowledge of fireworks came from 13th-century Arabs who were using gunpowder. In the same era, the English scientist Roger Bacon wrote a recipe for black powder in an anagram—perhaps not wanting to let the secret out too easily.

The earliest displays known in Europe were the work of Italians, who took their art to the courts of kings and queens. By the middle of the 18th century, English and French pyrotechnicians were competing seriously with the Italians. During a celebration of the Treaty of Aix in 1748, jealous French fireworks makers attacked the company of the famous Ruggieri brothers of Italy during final preparations for a great display in Paris. The resulting brawl—over whose display would be set off first—resulted in 40 dead and hundreds injured.

Shows of 'living' fireworks

Fireworks depicting heads of state were popular in facades in England a century ago, and many times over, Queen Victoria was thus honored. Living fireworks—men in asbestos suits covered with exploding, burning candles and shells—would sometimes act out pantomimes in these shows. The world's largest modern display took place in Quebec in 1908, involving huge firework portraits of historical figures on the bank of the St. Lawrence River opposite the city.

Besides the honor of the Monte Carlo extravaganza, the Grucci firm put on 12 nights of illuminations for the Winter Olympics last February, and supplies night shows for selected Mets baseball games in New York, as well as preparing all year for its 40-odd displays around the country on the Fourth of July. Largest of these is the \$25,000 celebration at the Washington Monument in the nation's capital.

The company makes 150 types of fireworks, including some Grucci calls pigeons, serpents and even a "flitter bomb." Says daughter Donna, "It's a combination of flutter and glitter, and 'glutter bomb' wouldn't have sounded right." Whatever its name, Grucci is happy to be making it. Summing up his attitude of 50 years in the business, he says, "I still love to see six months' work go up in smoke in five minutes." **PM**

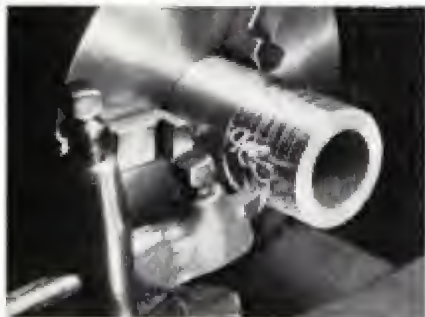
HINTS FROM READERS

Knife-honing guide



When honing a knife, use a spring clamp as an angle guide to maintain the desired blade bevel. Clamp the blade so it is at the proper sharpening angle when the clamp is resting on the stone.—*Walter E. Burton*

Cutting multiple threads



You can cut multiple threads on a lathe having interchangeable gears. You may, for example, want to thread mating parts so they can be engaged quickly with minimum rotation. In this case a double or triple thread will be useful. Place gears on the lathe as follows:

Thread	Screw Gear	Stud Gear	Pitch	Lathe Is Geared For
Double	24 teeth	48 teeth	1/8"	4 tpi*
Triple	32 teeth	48 teeth	1/16"	5 1/2 tpi*

*tpi: threads (turns) per inch of length

The data given here pertain to a lathe having a lead screw of 1/8 in. pitch and a thread dial that indicates 1/16 in. of saddle movement for each 1/8 revolution of the dial. Cut the double thread by advancing the thread dial enough to shift the carriage 1/8 in. from the first cut. Cut the triple thread by using the same thread-dial setting for each cut. Don't increase cut depth until the three threads have the same depth. The same dial setting will index three threads in a random selection, depending on the relative position of the thread dial and lead screw.—*Allen A. Austin*



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DRIVING THE PEUGEOT 505

(Continued from page 85)

traditional coil springs inside. There's plenty of fore-aft travel and full seatback-angle adjustment to provide a comfortable driving position for most anyone's shape and preference. The velour-covered cushions are soft enough for comfort, yet firm enough for proper support, and the front seatbacks have large cutouts to give rear passengers sufficient knee room.

Quick, agile and fun

Under the handsome body sits a chassis and suspension system worthy of a much more expensive car. Steering is power-assisted rack-and-pinion; suspension is fully independent with modified MacPherson struts in front, trailing arms with coil springs in back and antisway bars at both ends; brakes are four-wheel power discs with load-equalizing valves to prevent rear-wheel lock-up under all load conditions. All four wheels are designed to lock up simultaneously. Tires are Michelin high-performance, steel-belted radials, and weight distribution on the front and rear axle is a perfect 50/50.

And it works as well as it looks on paper—crisp, sure, no-surprises handling that, (for me) matches or surpasses anything else built with four doors and most so-called "sports cars." The great handling is matched with a supple, stable, comfortable ride that eats bumps.

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Priced at around \$12,000, the base U.S. 505 comes with tinted glass, electric rear window defroster, intermittent wipers, remote control outside mirror, tachometer (gas, five-speed only) and much more. **PM**

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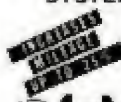
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HOW TO CREATE 'STAINED' GLASS

(Continued from page 99)

back panels. Cut the lamp wires to length *after* fixtures are in place. Make the splices as shown and secure them with solderless connectors (M). The connectors, canopy switch (L) and extra lamp wire are hardware and lamp-store items. After testing, remove the fixtures from the box. Permanently secure molding (D) to the frame with 1-in. brads (two per strip), and use wood filler in holes.

Sand again if needed. Dust and wipe with a tack rag. Apply a coat of sealer (pigmented shellac such as Bin or Enamelac) and let dry overnight. Sand lightly, dust and wipe with a tack rag. Apply paint, covering the inside, too, to aid reflectivity. Paint cleats (E,F) out of the box.

When parts are dry, lay the box face down and reassemble in this order: Install Casa panel. Install

cleats (E,F) using 3/4-in. brads. Install the lamps and arrange the wires around the frame. Keep them in place with insulated staples.

Install the back, remount the hardware and hang the unit from a pair of hefty picture hangers. Note

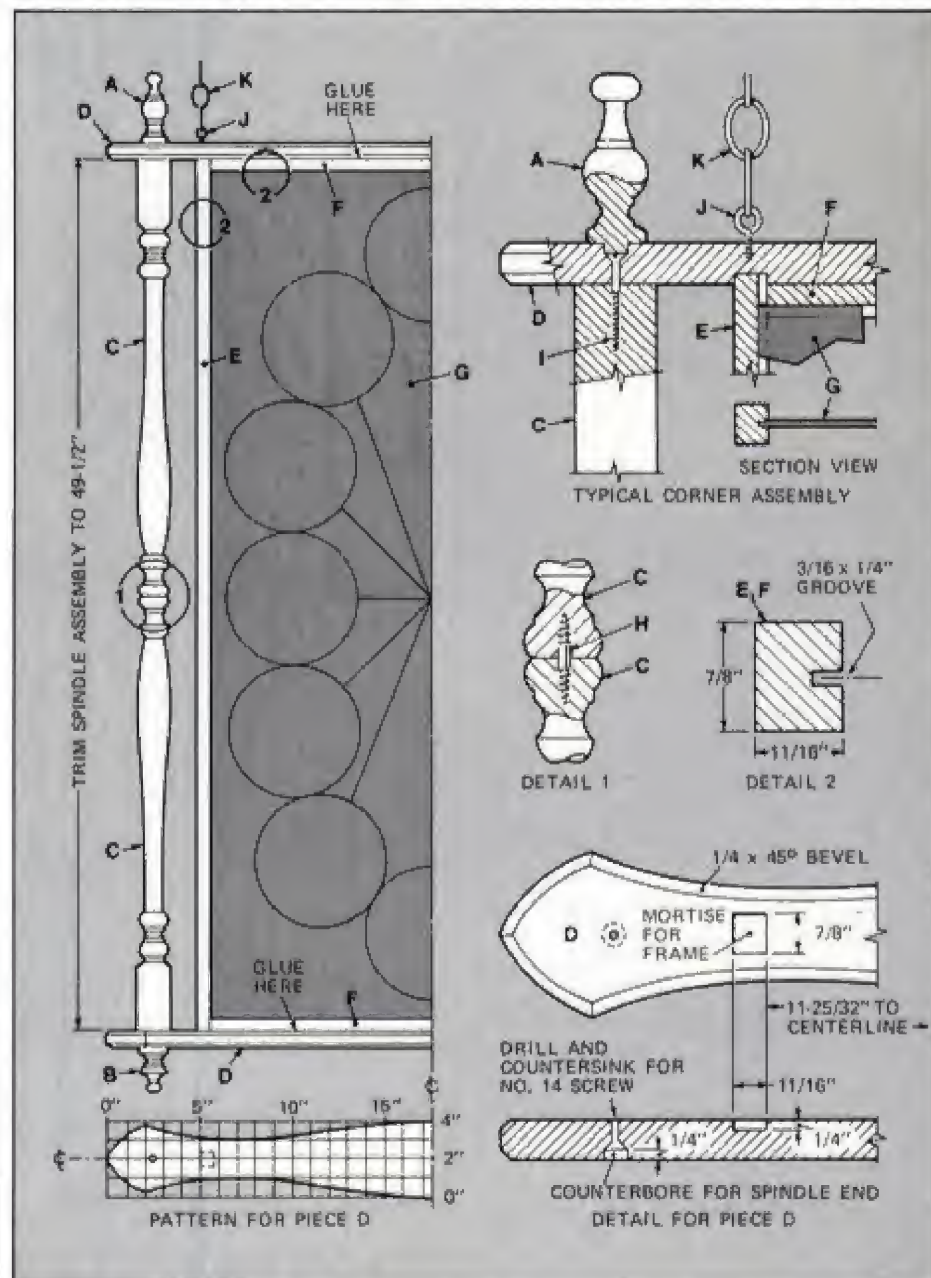
(Please turn to page 132)

MATERIALS LIST—ZODIAC PANEL

Key	No.	Size and description (use)
A	2	large spindle end
B	2	small spindle end
C	4	30" stock spindle turning or two 60" turnings
D	2	1 1/2" x 4" x 35" maple (cross member)
E	2	1 1/2" x 1/2" x 49 1/2" maple (vertical frame)
F	2	1 1/2" x 1/2" x 29 1/2" maple (horizontal frame)
G	1	1/2" x 24" x 48" acrylic sheet (decorative panel)
H	2	dowel screw
I	4	2" No. 14 screw
J	2	large-size screw eyes
K	2	chain as needed to suspend panel

Misc.: White glue and black Krylon semigloss spray paint. To glass-stain the panel, you'll need: full-size pattern; eye droppers; toothpick; four or five 4-oz. bottles of Titan's Liquid Pewter or Liquid Lead. Also, 2-oz. bottles of Glas Stain in the following colors: Red, 2 bottles (1"); Amber, 2 bottles (2); Light Blue, 2 bottles (3); Turquoise 2 bottles (4); White, 1 bottle (5); Yellow, 1 bottle (6); Lemon Yellow, 2 or 3 bottles (7); Pumpkin, 1 bottle (8); Pink, 1 bottle (9); Clear Extender, 1 bottle (10); and Hot Orange, 1 bottle (11).

*Numbers in parenthesis match color code on page 134.



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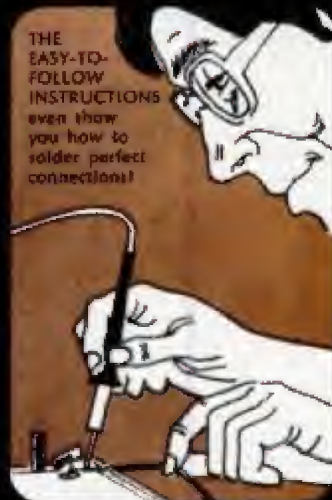
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HOW TO CREATE 'STAINED' GLASS

(Continued from page 130)

that lower screw eyes (O) act as spacers to keep the box parallel with the wall.

Dragonfly mirror

Start work on the mirror frame by cutting base frame (A). Sand, and then cut the frame molding (B), beginning with the inside pieces. These four pieces overhang the inside of the base frame by ¼ in. and form the rabbet that holds the mirror (E). Measure carefully and cut the miters on the inside molding pieces so that they are ½ in. less than the length and width of the base cutout. This creates the glass-holding rabbet. Attach with glue.

Measure, cut and attach the remaining molding pieces (B,C) using glue and 1¼-in. brads. Set brads slightly and fill holes with wood filler. Temporarily position the completed dragonfly mirror. Cut and test-fit molding (D); then remove mirror.

Sand the frame, if needed, before finishing it. Dust and wipe with a tack cloth. Apply two coats of McCloskey Heirloom Satin Varnish as directed, sanding, dusting and wiping with a tack cloth between coats. Reinstall mirror and back molding. Attach screw eyes (F) and picture wire (G).

Zodiac hanging divider

When you stain the zodiac panel, be certain that the edges of the circles are touching so that the background yellow doesn't flow into the center. Spindles (A,B,C) are ready-made and available at many lumberyards.

Rip four strips of hardwood (E,F) for the frame. Cut a ⅝ × ¼-in.-deep groove down the centers to hold the zodiac panel. Note: Acrylic expands and contracts, so make sure the panel is loose in the grooves to prevent stress.

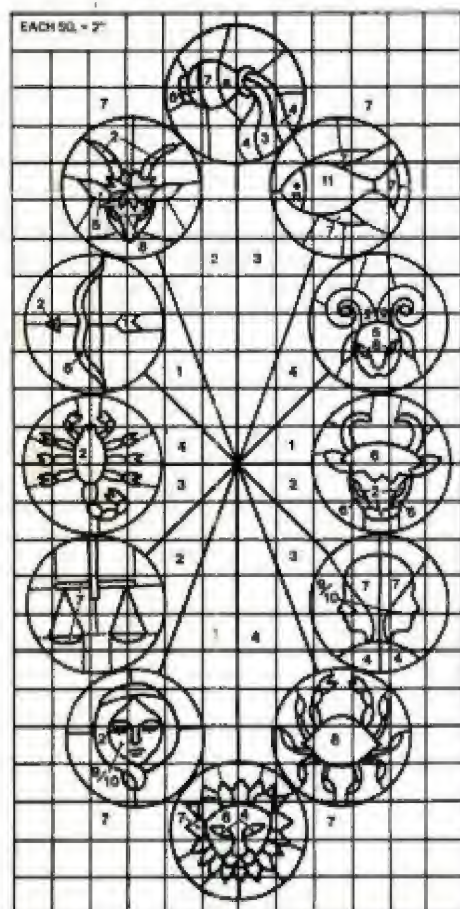
Cut the shaped upper and lower cross members (D) with a band or sabre saw. Sand the ripples smooth. Mortise recesses in D to receive sides (E). Bevel edges of D using a router with 45° bevel cutter.

Test-fit the frame parts with the zodiac panel in place. Nail and glue parts (F) in place. Trim spindles (C) to fit the assembly. Mark them before cutting so you can produce an accurate fit.

Clamp the spindles in place with bar clamps. Bore pilot holes for attachment screws through cross members (D) into the long spindles. Counterbore for the screwheads.

Assemble the unit without the zodiac panel. Attach screw eyes (J) and

chain (K); hang to paint. Finish end spindles separately. Disassemble, keeping mating parts together; reassemble with panel. **PM**

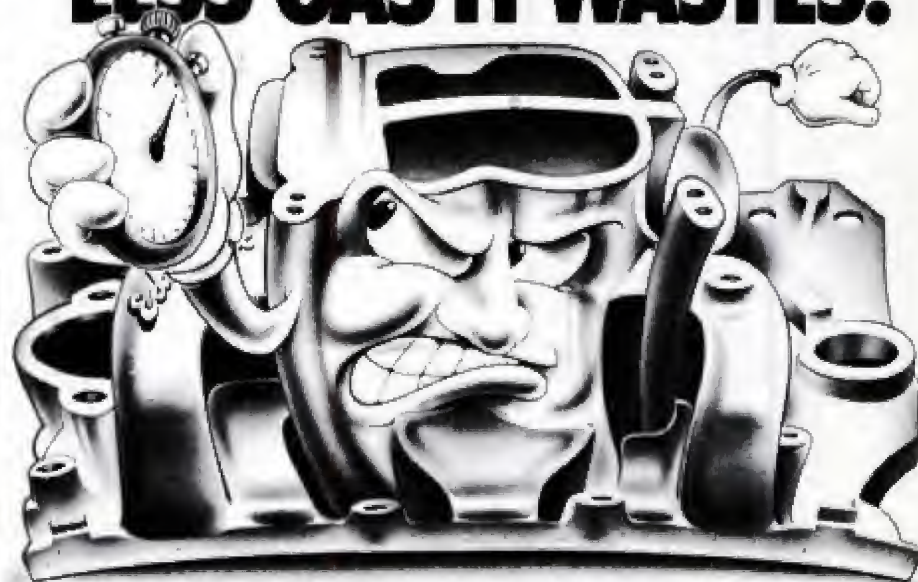


Make mortises in the cross members (D) by first boring $\frac{1}{4} \times \frac{1}{4}$ -in.-dia. holes to remove much of the waste. Chisel out remaining waste to the bottom of the hole.



Trim oversize spindles (C) to fit. Use a straightedge or square to mark the cut line.

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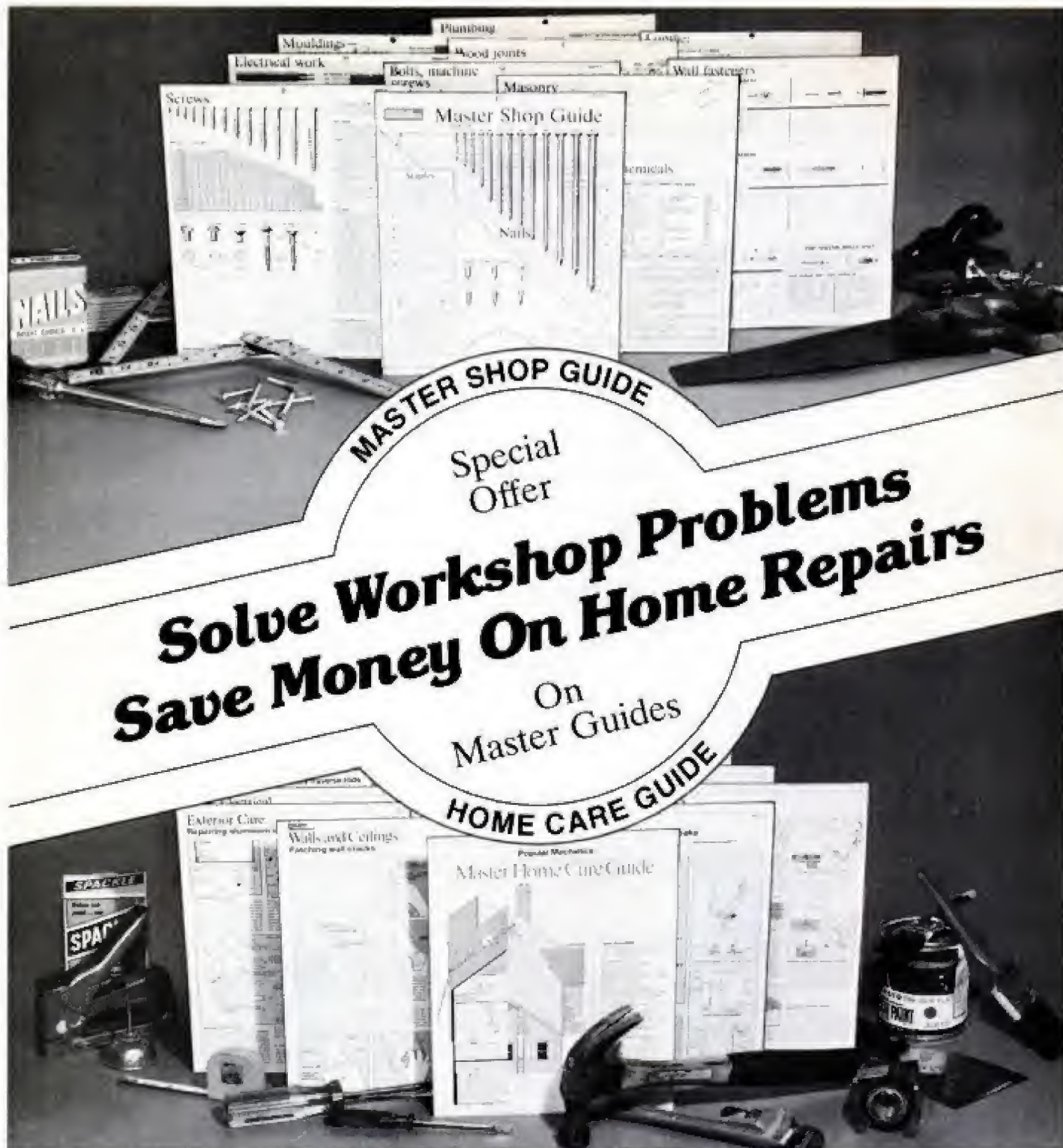


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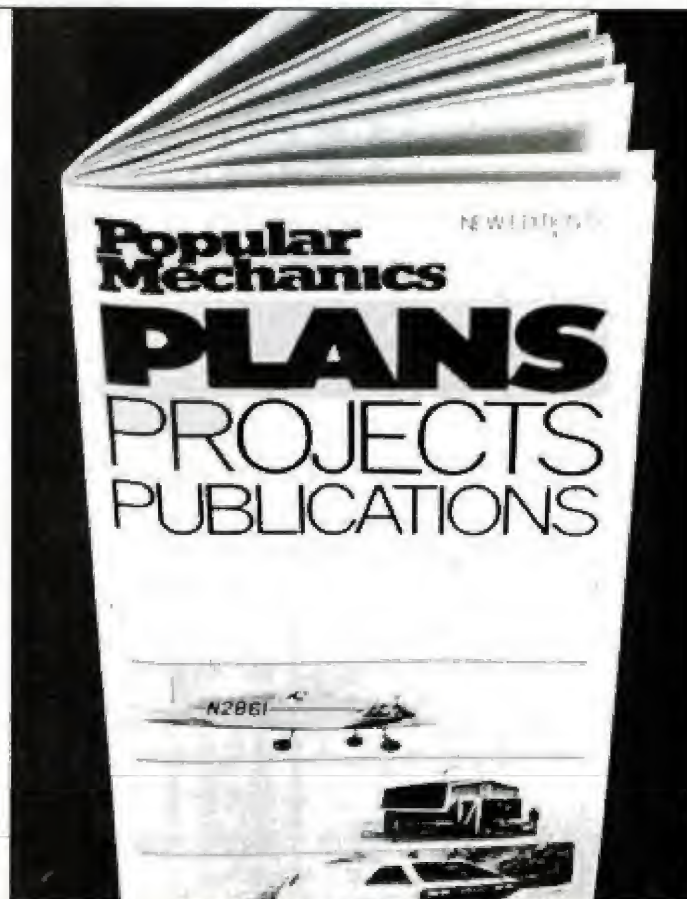
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PM LOOKS AT PARAMOUNT TRIMMER

Paramount's Rota-Shear Model 7802 put my lawn in blue-ribbon shape with little effort on my part. The machine is easily maneuvered by its double-D handle. Just



Paramount's No. 7802 cuts borders clean.

by tapping the trimmer's head on the ground, you get an extra inch of new cutting line. For long machine life, don't tap head on rocks or concrete.—*Glenn S. Hensley*



Adjustable, double-D helper handle lets you balance the load and direct the cut.



Dome cap at base of cutting head houses the automatic line-feeding mechanism.

SPECIFICATIONS—TRIMMER

Type motor: 80-hp permanent magnet with power boost
Cutting head: Mechanical with self-feed cord
Cutting swath: 16-in. dia., using .08-in.-dia. line
Cutting-line reserve: 40 ft.
Insulation: Double-insulated
Helper handle: Fully adjustable, "double-D" style
Amp. rating: 5
Weight: 8½ lbs.
Warranty: 1 year limited
Price: \$65
Manufacturer: Allegretti & Co., 9200 Mason Ave., Chatsworth, Calif. 91311



When trimming through tough stuff, use power switch for extra slashing force.

New from Stewart-Warner

Mini-Panel

The world's smallest instrument panel alerts you to car problems before they cause costly damage.

Mini-Panel is the miniaturized early warning system that helps you spot problems that develop while you drive. (Unlike traditional warning lights that don't go on until it's too late.) Catch those problems early, and you'll save yourself a lot of grief, as well as expense.

Each gauge serves an important function, enabling you to monitor electrical, cooling, and oil pressure systems at a glance.

Mini-Panel is so compact you can mount it on top of your dashboard—without obstructing your view of the road.

It's easy to install,* with no drilling or bolting. No unsightly wires, so you have a professional-looking installation.

You'll find Mini-Panel at auto supply stores and the automotive section of leading retail stores.

STEWART-WARNER ESTABLISHED 1954

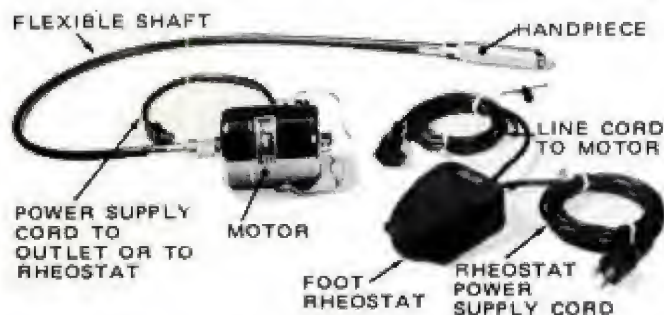
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*Mini-Panel fits U.S. made AMC, Chrysler, Ford and GM vehicles; adapters are available for most imports.

PM LOOKS AT COMPACT GRINDER



This easy-to-control handpiece is ideal for any intricate carving.



Model with 1/8-hp motor and solid-state rheostat is shown.

Whether you're carving, polishing or deburring steel, this flexible cable grinder will make the job easier. Its small handpiece allows access to those places impossible to reach with the larger, hand-held grinders. The snap-on handpieces come in three types, from the heavy-duty, keyed-chuck type supplied with the engine to a near-pencil-thin handpiece accessory (\$45) for light, delicate work.

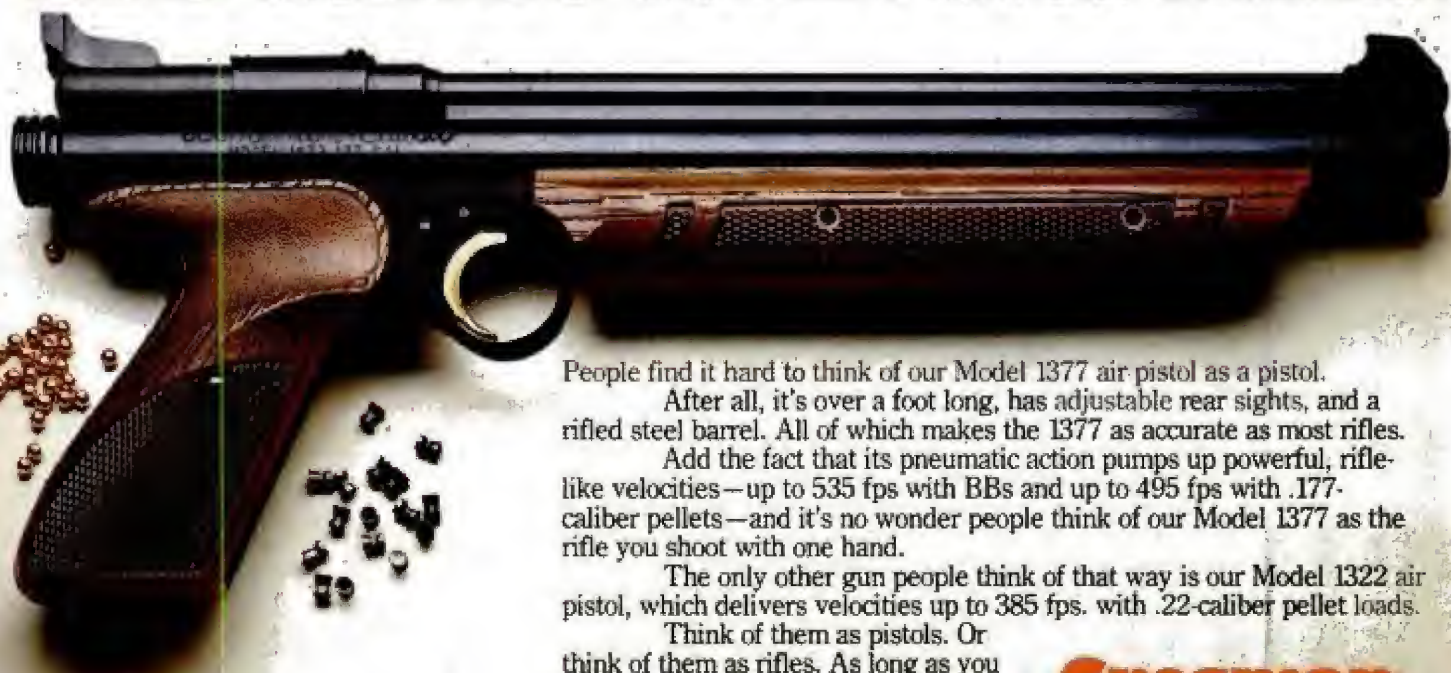
Our setup included the top-of-the-line, foot-control rheostat, which is best if you plan to use the tool for prolonged periods at low speeds. The 1/8-hp engine performed well while carving walnut and deburring steel. A 1/4-hp engine is also available. The 1/4-hp engine develops up to 14,000 rpm, while the 1/8-hp engine reaches 20,000 rpm.

Standard setup No. 23-981 includes the 1/8-hp engine, a flexible cable, a six-speed rheostat and a handpiece for \$70, from Abbey Materials Corp., Atlantic Ave., Brooklyn, N.Y. 11207—*John Gaynor*



Grinder motor can be suspended from ceiling to eliminate back pressure on the handpiece while carving.

THINK OF IT AS THE RIFLE YOU SHOOT WITH ONE HAND.



People find it hard to think of our Model 1377 air pistol as a pistol.

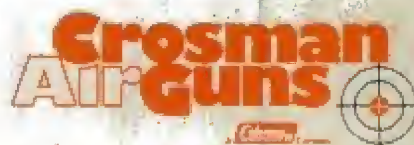
After all, it's over a foot long, has adjustable rear sights, and a rifled steel barrel. All of which makes the 1377 as accurate as most rifles.

Add the fact that its pneumatic action pumps up powerful, rifle-like velocities—up to 535 fps with BBs and up to 495 fps with .177-caliber pellets—and it's no wonder people think of our Model 1377 as the rifle you shoot with one hand.

The only other gun people think of that way is our Model 1322 air pistol, which delivers velocities up to 385 fps. with .22-caliber pellet loads.

Think of them as pistols. Or think of them as rifles. As long as you ask for them by name.

The Crosman Model 1377 American Classic.™ The Crosman Model 1322 Medalist.™



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"SHE GOT ME INTO A SLING"

I had no idea what I was getting myself into when Tamara handed me that drink and said, "Try this, Jimmy."

I took a sip. Immediately, I was riveted by the taste—a stunning blend of cherry brandy and gin.

It gave me a maddeningly delicious thrill.

I demanded to know what she had done to me. That's when I saw an exotic-looking bottle with a label that read: HEUBLEIN SINGAPORE SLING.

Ever since that unforgettable evening, it's been one of my favorite drinks.

And I'll always be grateful to Tamara...the woman who first introduced me to the delights of a Singapore Sling.



Singapore Sling—made with Gin, Cherry Flavored Brandy, Natural Flavors and Artificially Colored. 35 Proof © Heublein, Inc., Hartford, CT.

COMING: BIG-SCREEN TV BY LASER (Continued from page 26)

by a seven-foot rectangular console having light-emitting diode readouts (LEDs). The console is programmed for all operating and high-voltage measurements, but also does the actual alignment of all receiver IF, sound and AFT (automatic fine tuning) circuits before the chassis is mated with tuner and cabinet—all in an elapsed time of 45 seconds.

Stereo sound and world TV

By 1982, stereo will be virtually a foregone conclusion. Electronic Industries Assn. (EIA) tests are beginning now on several systems from the United States, Japan and Europe, and should be completed in time for the Federal Communications Commission to evaluate and approve, so this service can become available soon. "Stereo ready" sets could well be on the market next year, with simple inserts for future converters.

At the same time, 1982 could also see the introduction of an international TV receiver which has already been proposed by Plessey Semiconductors Ltd. of Swindon, England. The German, French, American and Russian TV standards are all different, but according to Plessey, they can soon be received on one TV.

Goodbye to ghosts

Circularly polarized (CP) antennas are the result of as many as a dozen TV stations installing equal vertical and horizontal signal outputs, along with transmitting antennas that produce either right-hand or left-hand polarized electromagnetic wave patterns. These signals can be received by standard TV antennas, but are much improved by CP antennas that actually pick up significant gain (3 db) because of having both vertical and horizontal elements.

CP, when teamed with electronic ghost-cancellation schemes under development, can become a powerful combination. Work is proceeding in some video and solid-state companies to produce filters and system-controller devices that will identify the ghost and cancel the multipath image. We should see some of these dual results during 1983.

Satellite and cable TV

The Communications Satellite Corp. (COMSAT) has already, or will shortly, request authority from the FCC to put up a satellite for direct home communications by 1983. Our guess is that home service, based on pay TV and CATV cable charges, will begin about 1984, initially offering two channels for home TV viewing, with more as the service prospers. Monthly charges will include a four-foot housetop parabolic receiving dish and a down-converter from 12 GHz to one or two of your ordinary TV channels. Since it is a synchronous satellite in stationary orbit, you'll essentially flip a switch on the converter and enjoy wideband TV with virtually nonexistent noise and beautiful pictures.

Meanwhile, don't forget cable television (CATV), now serving one in every five TV homes in the United States; by 1986, it should be connected to one in three.

Cable TV has grown into a huge industry where computer monitoring of homes and industry for fire, security and health, plus full two-way communications will become routine in the '80s. Already, there are over 17 million subscribers, with an annual growth rate calculated at some 20 percent.

New video cassettes

With no video cassettes made in the United States, and most originating from Japanese sources such as

(Please turn to page 142)



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- Important rust-arresting benefits for a long term cure
- Adds years of "New Car" life to your automotive investment
- Unconditionally Guaranteed or your money back

Finally, an inexpensive alternative to "Planned Obsolescence" For years we American car owners have accepted short life spans for our vehicles. We've watched helplessly as their shiny bodies and chrome trim suffered all too soon from corrosion, and those destructive, ugly rust spots got bigger and bigger, eating right through the metal in a few months. Until now our choices haven't been easy: Spend a fortune at the body shop, or trade it in and start the process all over again, much to Detroit's delight.

Rust-Biox...A New Miracle, "No-Hassle" Automobile-Body-Saver! Rust and corrosion are inevitable "metal-diseases" (helped along by winter weather, road and ocean salt, and rainy seasons) that sooner or later will affect your vehicle, boat, plane, etc. Like human ailments, the critical factor for a full recovery is early detection, and a prompt, effective cure. Once you discover that first spot of rust on your car, a quick easy Rust-Biox treatment can mean the difference whether your car's body (and/or engine parts) will survive this "killer" problem or not.

Now there is no excuse for any car to be prematurely ruined by this costly "Auto-Epidemic"...

Simple to use. Just spray it on and rinse it off a short time later! Rust-Biox generally requires no rubbing or labor of any kind. It works selectively, completely destroying rust and tarnish, without harming metals, paint, plastics, rubber, wood, textiles, ceramics, or people. Other products (conventional rust removers and converters, etc.), are usually dangerous poisonous acids that can destroy almost anything...including your skin, as well as your car's metal, paint, etc.

Non-Polluting Rust-Biox is so safe you can apply it with your bare hands and since it is not an acid, it can be sprayed for easy, quick application. After spraying, wait the required time (15 minutes to 2 hours normally, depending upon the degree of rust and air temperature), then merely rinse it off with water. The thorough rust-eating enzymes do the dirty work for you!

Important - unique "Rust-Arresting" powers! Our research shows that after most conventional rust removers are used, rust begins again almost immediately, within 10 seconds after use! However Rust-Biox has been professionally designed to give you a full 24-48 hours of guaranteed rust-free protection, allowing plenty of time to seal or touch-up paint the treated area. Thus, early detection followed by a Rust-Biox treatment, followed by a sealer or touch-up paint completely

guarantees you a permanent rust-free solution that no other product can offer. This popular European product can literally provide you a car with no rust damage to depreciate its value and shorten its life.

Hundreds of other household and industrial uses... Rust-Biox completely removes rust, tarnish and oxides from iron, steel, copper, brass, chrome, and aluminum - safely! Use it on bikes, boats, antiques, screens, tools (also removes concrete mortar), baths, basins, plumbing systems, stove burners, frying pans, even for coffee stains on dishes. You'll use Rust-Biox in dozens of places you'd never dream of using the acid-based products. In the industrial sector Rust-Biox usage is booming, particularly in pollution-sensitive and health-related industries such as food-processing, medical, etc.

Concern for the environment in Scandinavia is a way of life, and Americans are becoming equally aware. Biodegradable, 100% Organic Rust-Biox can be rinsed down the drain without harm to plumbing systems, and it poses no "poison threat" when stored in the home. And most importantly, Rust-Biox encourages us all to preserve what we have, rather than allowing our costly automobiles to waste away from needless rusting. It is now easier to maintain your car rather than replace it, even if you can afford to do so.

We dare you!

Try Rust-Biox on any rust you can find, no matter how severe, and return the balance within 30 days for an unconditional, no-questions-asked refund if you're not 100% satisfied.

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COMING: BIG-SCREEN TV BY LASER

(Continued from page 140)

Matsushita, JVC (Victor of Japan), Sony and Hitachi, intense overseas competition brings new developments virtually every hour on the hour.

Further, before the year is over, a longer-recording VHS stretch tape is expected from Japan that will play up to nine hours! Obviously, tapes won't stretch indefinitely, and high resolution player-recorders must meet competition from the discs. It's reasonable to assume some future system of cassette feed that's automatic and will accept a number of standard-play tapes, just like an LP automatic record player. Perhaps, then, you'll be able to play programs for a month.

Teletext and Viewdata

Videotext information systems are now being tested in the United States, Canada, France, West Germany, the Netherlands, Denmark, Finland, Sweden, Spain, Switzerland, Hong Kong and Japan and are already operating on a regular basis in Great Britain under the names Cee-Fax or Oracle and Prestel. In the United States, the first

two are lumped together under the generic term Teletext, and Prestel is known as Viewdata.

Both are information retrieval systems, but Teletext is usually broadcast over existing television stations, while Viewdata travels over telephone lines. The British post office has recently opened a Viewdata computer-based information service, available equally to householders, specialists and non-professionals. Customer access centers are located in London, Manchester, Birmingham and other United Kingdom cities.

Teletext can produce approximately 4 million pages of information per hour. Attractive consumer costs for additional electronics to receive combined Viewdata and Teletext are estimated at 20 percent of set price, or 10 percent for Teletext alone.

In the United States, tests and market strategy are still under way to determine both the best broadcast-wire systems and also how to render these services profitably. Right now, we have no precise timetable of availability.

Laser TV and flat screens

Already proven in the laboratory and virtually assured of a tremendous future are laser-projection, big-screen receivers which will, ultimately, display all this TV, CATV, satellite, computer, Viewdata and Teletext information, probably in three-dimensional or holographic images suspended in space (see CCD Cameras, page 26).

Hitachi, for instance, is known to have been working for some time on laser-projection systems, as well as holographic recording techniques for videodiscs, and there are reports from Europe that Philips is engaged in similar research.

Whether a flat wall display comes in the form of a plasma screen, light-emitting diode matrix, laser beams, or some collection of all three, remains to be seen. But a fully digitized receiver with a highly effective laser-projection system seems to be a logical choice. Meanwhile, looking down the road a few years, you may well be viewing 3D and laser holography (diffracted waves with coherent background) before 1990 is laid to rest. **PM**

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DRIVING THE ROVER 3500 AND TRIUMPH TR8

(Continued from page 69)

Displacement remains at 215 cu. in. or 3528 cc.

The current Rover V8 uses larger valves and better hydraulic lifters than the old Buick/Olds version. It also boasts Lucas-Bosch fuel injection instead of carburetion. Actually, on the 1962-63 Olds F-85, you could buy this engine turbocharged. Until recently the Rover V8 had twin SU carbs but to pass U.S. smog requirements, fuel injection became a must for the 3500.

Dual-purpose interior

I found the Rover sedan extremely roomy, with generous leg space even in the rear. The steering column has a large adjusting collar, or "rowel," as the British call it, just inside the driver's glovebox. Unscrew the rowel and you can move the wheel in, out, up or down.

Instrumentation, contained in what amounts to a vinyl box atop the dashboard, is very complete. Almost every gauge has a backup warning light, and there are also telltales for buckled seat belts, rear-glass demister, bulb failure, oxygen sensor and so on.

The twin gloveboxes and "podular" instrument housing makes it easier for Rover to accommodate either right- or left-hand steering.

With reclining front seats and a folding rear bench, there is so much space that two people can use the Rover comfortably as a temporary motel room. With the rear seat up-right, there are nearly 12 cu. ft. of luggage space beneath a removable parcel shelf. Or put the back seat down and you end up with a station-wagonlike 35.4 cu. ft. of cargo capacity.

Steering and handling

Steering is power assisted and extremely quick: only 2.8 turns lock to lock. It's unexpectedly fast, but very positive, and a great addition to the driving pleasure of this car.

The Rover corners well, too, despite a straightforward suspension system (MacPherson struts up front, live rear axle). The standard Michelin steel-belted radials help, and the front rollbar and rear Watts linkage assure a level cornering stance. The rear suspension also incorporates self-leveling shock absorbers to compensate for heavy loads, and to keep the headlights properly aimed.

In all, I found the Rover an extremely pleasant, cooperative, enjoyable car to drive. Prices weren't set at press time, but the 3500 sedan

is expected to sticker between \$16,000 and \$17,000. That means it's just below the BMW 528i and Mercedes 240D.

To many American buyers, BMW and Mercedes sound like better names, but it might not take long before the Rover is recognized in those circles.

Driving Triumph's new TR8

Triumph engineers have taken the TR7 convertible, removed the four-cylinder engine, dropped in Rover's aluminum V8 and christened the result the TR8.

It's what they should have done in the first place. The TR8 reminds me very much of the Sunbeam Tiger, which again shoehorned an American V8—in this case the 260/289 Ford—into the lightweight 1964-67 Sunbeam convertible.

The Triumph TR8 uses basically the same five-speed overdrive transmission and rear-axle center section as the Rover, but in a package that's about 600 pounds lighter. Result: a car with a better power-to-weight ratio. It really moves.

Part of the reason for the TR8's zippiness is the fact that this V8 will rev comfortably to 6000 rpm. The old Buick/Olds version ran out of breath around 4700 rpm due to lifter pump-up. BL has an improved lifter design, and the result shows up in a nicely expanded rev range.

We were forever burning rubber in this car. Zero to 60 takes 8.5 seconds. The TR8 begs for abuse, but it seems to withstand a lot of hot rodding without complaint.

The aluminum V8 weighs roughly 100 pounds more than the TR7's Four. That means a bit more nose heaviness, but no more than the Four with airconditioning. The TR8 handles and corners well, yet has a very acceptable ride.

For federal models, the TR8 comes with twin Zenith-Stromberg carburetors. California engines use the same Lucas-Bosch fuel injection as the Rover, but with the plenum chamber turned around left to right so that it would fit.

The only other change from the TR7 are cast alloy 13-inch wheels and the addition of the Rover's power steering unit. The TR8 goes for about \$2000 more than the TR7 convertible which lists at \$9235. The TR7 continues in production in both coupe and convertible forms. The TR8 comes as a convertible only.

As I see it, JRT has a couple of winning combinations in its showrooms.

FM

THOSE AUTOMATIC CAMERAS

(Continued from page 73)

trol more practical, too—you don't have to be there to wind the film between shots. Radio controls, good for distances of up to 300 yards or so, are now available from many manufacturers (even when marketed for a particular camera, they'll frequently fit others). And Contax has long had an infrared remote control (shown below) which only operates over a 20-meter range, but which, unlike radio controls, can be used legally in any country.

Ever forget just where and when you shot your pictures? Today's cameras can jog your memory, too.



Contax 137 MD, shown with infrared remote controller, has a built-in power winder.

Many 35-mm reflexes now can use accessory data backs that print the date or a code number on the film as you shoot it (Canon even has a 110 pocket camera equipped with a built-in dater).

Built-in warnings

Today's cameras give you lots of information while you're shooting, too. Most of today's electronic models show you either which f-stop or shutter speed you're using, or both. Many also show flash status, warn of over or underexposure, and let you know when you've overridden the auto-exposure system to use a backlight compensator or go into manual mode, and when speeds are too slow for blur-free shooting. Contax's new 137 MD even lets you see the frame counter while you're shooting.

Cameras don't talk, yet. But they're already making noises: Minolta, for example, has a new 110 camera which beeps when light is low.

Chinon's new 35F-M camera, a compact 35 with built-in winding motor, beeps when its battery is running low or film is running out. With all the new talking appliances, the talking camera can't be too far behind.

FM

and didn't explain anything about the car on delivery. I'd rate the service staff as average."

But a Tennessee letter carrier: "My salesman was very fair and honest, truthful and courteous. And the dealer's mechanics give me fast and excellent service."

When we asked what changes Caprice owners would like to see, 24.2 percent voted for no changes at all. A cross section of suggestions were these:

"Put a full-sized spare tire in the trunk."—Wisconsin farmer.

"Get rid of the jerkiness in the lockup torque converter, give us better gas mileage with the 267-inch V8 and put the electric-window buttons into the armrest."—Illinois school principal.

"I'd rather have a separate switch for the radio antenna—rather than having it go up every time I turn on the radio."—Alabama clergyman.

Many respondents were longtime Chevrolet buyers whose brand loyalty shone through. A California electrical contractor, for instance, told us, "I've purchased 10 Chevrolet passenger cars since 1941. The last three have been Caprices, and we've been well pleased with all of them."

A Texas police officer and his wife own two Caprices—a 1979 model and an '80; both are coupes with the 5.0-liter V8. "I've driven cars all my life for a living," notes the officer, "and I prefer Chevrolets. These are the most comfortable cars



The 57.6-in.-wide rear seat can hold three adults. The front legroom is good, too.

we've ever had—plenty of room, no complaints from the rear and we've gotten only compliments from our front-seat passengers.

We especially like the quick acceleration and pickup, the gasoline mileage, the silence, the smoothness and last, but not least, the fact that they're tough and virtually maintenance-free."

A Nebraska retiree: "I've had three Caprices before this one. I stick with them because the dealer gives good service, they're nice-looking, easy to handle and get good gas mileage."

A South Carolina truck driver, who has owned two Caprices since 1971 and currently owns two other Chevies, had this to say: "All the Chevies that I've ever owned have never given me the slightest trouble. Except for the transmission, this is the best one I have had yet."

An Alabama electrician states, "I have been driving Chevrolets for 25 years and they give me everything I like in a car. My Caprice looks great, has lots of room, handles like a car should. I think it's terrific."

And an Illinois retiree had this opinion. "I've bought a new Chevy every year for 33 years, so I can compare this one pretty well. I have no complaints with it and there isn't a thing that I would want to



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change on it."

Fully 92.8 percent of the Caprice owners we surveyed said they would buy another Chevrolet as their next purchase. And 90.4 percent told us that next car would be another Caprice. These are very high figures and speak well for owner satisfaction.

The final word and proof of broad con-

fidence in Chevrolet come from an Alabama teacher, who added the following to the back of his questionnaire.

"We are so pleased with our 1980 Caprice Classic wagon," he wrote, "that we would like to add this note. We decided to buy our diesel wagon because we needed a full-sized car that would give us good fuel economy. The car has turned

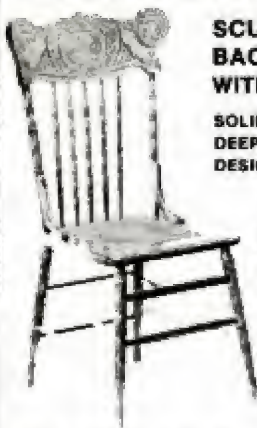
out to be *much* better than we expected. The engine is extremely smooth and very quiet, except at low speeds. We are getting better mileage than we received from the small Datsun that we owned previously—plus much more comfort. On top of that, we have had absolutely no problems from our Caprice. We believe that this is a superior quality car in every way." **FM**

SUMMARY OF 1980 CHEVROLET CAPRICE OWNERS REPORTS*

Total miles driven 551,374	Specific likes:	Very good 30.9	Fair 5.6
Average miles per gallon	Styling 50.0%	Good 12.5	Poor 7.0
3.8-liter V6	Comfort 40.0	Fair 3.9	
In town 17.1	Ride 33.6	Poor 0.0	
Long trips 22.0	Handling 32.9		
4.4-liter V8	Economy 27.1		
In town 15.6	Specific dislikes:	Comfort opinion (rear seats):	Number of vehicles owned:
Long trips 20.1	No complaints 40.0%	Excellent 43.8%	Chevrolet Caprice only 46.8%
5.0-liter V8	Gas mileage 8.5	Very good 30.8	Two cars 41.6
In town 15.6	Poor workmanship 7.7	Good 17.7	Three cars 8.4
Long trips 20.5	Transmission 7.7	Fair 6.9	Four or more cars 3.2
Engine choices	Mini spare 5.4	Poor 0.6	
3.8-liter V6 14.8%	What changes would you like?	Had any mechanical trouble?	Makes of cars owned:
4.4-liter V6 51.6	No changes 24.2%	No 62.3%	Chevrolet 59.8%
5.0-liter V8 33.6	Better gas mileage 12.9	Yes 37.7	Ford 12.2
Body-style choices:	Transmission lockup improved 8.9		Cadillac 8.5
Four-door sedan or wagon 77.8%	Relocate window switches 8.1	What type of trouble?	Pontiac 7.3
Two-door sedan or coupe 22.2	Re-engineer seats 8.1	Transmission lockup 17.5%	Age distribution of owners:
Why did you choose the Caprice?	Workmanship opinion:	Carburetor 10.5	15-29 years 4.6%
Styling 28.9%	Excellent 30.1%	Alternator 10.5	30-49 years 32.6
Past experience 24.8	Good 49.0	Dealer repairs satisfactory?	50-plus 62.6
Size 19.5	Average 11.1	Yes 66.7%	
Economy 14.8	Fair 5.2	No 33.3	Would you buy another Chevrolet product?
Performance 7.4	Poor 4.6		Yes 92.8%
	Comfort opinion (front seats):	Dealer service opinion:	No 7.2
	Excellent 52.6%	Excellent 39.1%	Would you buy another Caprice?
		Good 40.6	Yes 90.4%
		Average 13.4	No 9.6

*Percentages might not equal 100% due to rounding or insufficient data.

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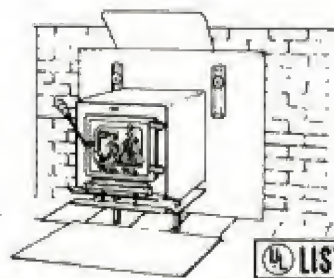
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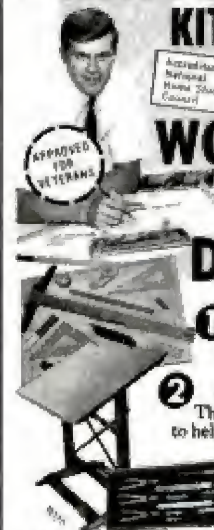
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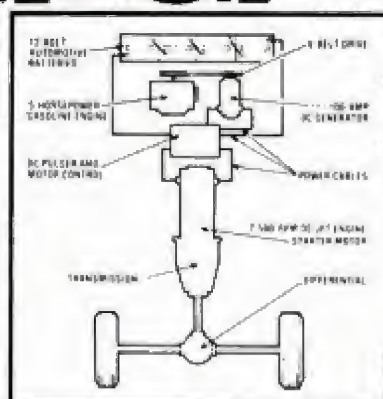
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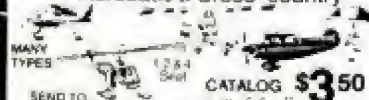
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